

Project Manual for

Wayne State University
Biology Bond Issue Renovations
Detroit, Michigan
WSU Project No 089-241040

Ghafari Project No. 137378
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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Demolition and removal of selected portions of building or structure.

1.2 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.

1.3 MATERIALS OWNERSHIP

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

1.4 PREINSTALLATION MEETINGS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

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

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

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

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect/Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect/Engineer and Owner. Hazardous materials will be removed by Owner 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.

1.9 COORDINATION

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

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with 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 Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least **<Insert number>** hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect/Engineer, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 02 41 19

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for roof openings and miscellaneous applications.

1.2 COORDINATION

- A. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for mechanical and electrical equipment.
 2. Steel framing and supports for roof openings and miscellaneous applications.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: Keep data on file at the project site, subject to review by the Architect/Engineer, upon request.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- D. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: As indicated.
 - 2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units installed after concrete is placed.

2.6 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.7 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
1. Shop prime with universal shop primer unless indicated.
- B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

END OF SECTION 05 50 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Wood blocking and nailers.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.3 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent.

2.2 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:

1. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWP.
 2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWP.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- C. 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.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 06 10 53

SECTION 07 54 00 - ROOFING SYSTEM MODIFICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cutting and patching of an existing polyvinyl-chloride (PVC) roofing system to accommodate new construction.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Owner's insurer if applicable, roofing Installer, roofing system manufacturer's representative, and other installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing cutting and patching, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review structural loading limitations of roof deck during and after roofing.
 - 5. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 6. Review governing regulations and requirements for insurance and certificates if applicable.
 - 7. Review temporary protection requirements for roofing system during and after cutting and patching work.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Original roof manufacturer.
- B. Roofing Installer Qualifications: The existing roofing system is covered under provisions of a manufacturer's warranty. Engage the original roofing system Installer to provide, or supervise provision of, roof protection systems during construction; and to perform all cutting and patching operations.
 - 1. If the original roofing system Installer cannot be engaged to perform the Work, engage another Installer licensed and approved by the manufacturer of the existing roofing system to perform cutting and patching operations in conformance with all provisions of the existing roofing system warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Existing roof is covered under the provisions of a roof warranty. Perform roof cutting and patching operations in a manner and using materials that will not void or otherwise compromise existing roof warranty.

PART 2 - PRODUCTS**2.1 ROOF SYSTEM MATERIALS**

- A. Use only those materials manufactured or approved by the existing roofing system manufacturer for cutting and patching, and that will not void any provision of the existing roofing system warranty.

PART 3 - EXECUTION**3.1 ROOFING SYSTEM MODIFICATION**

- A. Protection: Protect existing roofing membrane materials cutting and patching operations. Use engineered wood panel products with fabric protection layers or similar means to protect roofing from damage during cutting and patching operations. In general, protect as required to eliminate:
 - 1. Scuffing, tears, and punctures of existing roofing membrane.
 - 2. Irreversible compression of existing roof insulation, creating water-traps or ponding.
 - 3. Damage to flashing, terminations and other details.
- B. Cut and Remove Roofing: Neatly cut and remove roofing system limited to the extent consistent with accommodation of new construction and as required to comply with roofing system manufacturer's standard patching details.
- C. Patch and Extend Roofing: Patch, and where indicated, extend roof system to maintain thermal insulation value, watertight integrity, solar reflectance, and all other properties of the original roof system. Patch in accordance with manufacturer's standard details for conditions encountered and in accordance with all provisions of the existing roofing warranty.

3.2 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.3 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect/Engineer and Owner.

- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION 07 54 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Roof curbs.
- B. Related Sections:
 - 1. Division 23 Sections for standard curbs provided with roof mounted mechanical equipment and specified by reference to this section. Curbs furnished with mechanical equipment are installed under provisions of this Section.

1.2 COORDINATION

- A. Existing roofing system is covered under provisions of an existing warranty. Coordinate installation of roof curbs with requirements of Section 07 54 00 "Roofing System Modifications" to eliminate the possibility of voiding or compromising the existing roofing system warranty.
- B. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- C. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Curbs Plus, Inc.
 - b. Greenheck Fan Corporation.

- c. LM Curbs.
 - d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - e. Pate Company (The).
 - f. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
 - g. Roof Products, Inc.
 - h. Thybar Corporation.
- B. Size: As required for equipment to be supported.
- C. Supported Load Capacity: As required for equipment to be supported.
- D. Material: Zinc-coated (galvanized) steel sheet, 0.079 inch thick, unless otherwise indicated or required to provide sufficient support of equipment.
 - 1. Finish: Baked enamel or powder coat.
 - 2. Color: As selected by Architect/Engineer from manufacturer's full range.
- E. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
 - 5. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
 - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 7. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
 - 8. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.2 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
 - 1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

- B. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, and complying with AWPAC2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical-and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
 - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

1.5 INFORMATIONAL SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use 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 work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. Deansteel Manufacturing Company, Inc.
 - 4. Republic Doors and Frames.
 - 5. Steelcraft; an Allegion brand.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2..
 - 1. Physical Performance: Level B according to SDI A250.4.

2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Face welded.
4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
1. Fire Door Cores: As required to provide fire-protection[**and temperature-rise**] ratings indicated.
 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 3. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Provide countersunk, flat-or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold-or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with **[butted]** **[or]** **[mitered]** hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Provide fixed frame moldings on secure side of interior doors and frames.
 3. Provide loose stops and moldings on inside of hollow-metal work.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

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

2.8 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat-or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. 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.

END OF SECTION 08 11 13

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SECTION 08 45 13 - STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum-framed assemblies glazed with structured-polycarbonate panels as replacement skylight assemblies.
- B. Unit Prices: This Section is affected by the following Unit Prices to be reported on the Owner's form within the Bidding Documents:
 - 1. Unit Price No. 1: Remove and replace flashing at masonry walls:
 - a. Description: Removal of existing deteriorated aluminum sheet metal flashing and counterflashing along joint between greenhouse glazing system and masonry rising walls. Conditions at rake walls and gutter are both included in this Unit Price. Flashing section embedded in masonry wall is to remain in place. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of flashing replaced.
 - 2. Unit Price No. 2: Remove and replace internal gutters:
 - a. Description: Removal of existing deteriorated internal aluminum sheet metal gutter systems at greenhouse valleys and end wall adjoining masonry rising walls. Include gutter sheet metal, connections, attachments and brackets, and EPDM gutter liner. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of gutter replaced.
 - 3. Unit Price No. 3: Replace EPDM gutter liner:
 - a. Description: Replacement of existing deteriorated EPDM gutter liners, with existing gutters and liners to remain in place, covered by new liner. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of gutter liner replaced.
 - 4. Unit Price No. 4: Replace ridge caps:
 - a. Description: Remove and replace existing deteriorated aluminum sheet metal ridge caps with new ridge caps. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of ridge cap.
 - 5. Unit Price No. 5: Replace rake edge trim:
 - a. Description: Remove and replace existing deteriorated aluminum sheet metal rake edge trim with new rake edge trim. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of rake edge trim.

6. Unit Price No. 6: Replace battens between glazing panels:
 - a. Description: Remove and replace existing deteriorated aluminum sheet metal battens between glazing panels. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of battens.
7. Unit Price No. 7: Replace coping (window sill):
 - a. Description: Remove and replace existing deteriorated aluminum sheet metal coping (window sills) where base of greenhouse walls meet vertical building walls. Match materials and details of existing construction.
 - b. Unit of Measurement: Linear feet of coping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.
- B. Shop Drawings: For panel assemblies.
 1. Include plans, elevations, sections, details, and attachments to other work.
 2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
- C. Samples: In manufacturer's standard size.
 1. For each type of structured-polycarbonate panel.
 2. For each type of exposed finish for framing members.
- D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:
 1. Joinery.
 2. Anchorage.
 3. Expansion provisions.
 4. Structured-polycarbonate panels.
 5. Flashing and drainage.
- E. Delegated-Design Submittal: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: For each structured-polycarbonate-panel assembly, for tests performed by a qualified testing agency.

- C. Evaluation Reports: For structured-polycarbonate-panel assemblies from ICC-ES.
- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Water leakage.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace structured-polycarbonate panels that exhibit defects in materials or workmanship within specified warranty period.
 - 1. Defects include, but are not limited to, the following:
 - a. Delamination.
 - b. Color changes exceeding requirements.
 - c. Losses in light transmission beyond 6 percent from original when measured according to ASTM D 1003.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design structured-polycarbonate-panel assemblies. Responsibilities include:
- B. Structural Loads: As indicated on Drawings.
- C. Deflection Limits for Overhead Panel Assemblies: Limited to 1/120 of clear span for each assembly component.
- D. Structural-Test Performance: Panel assemblies tested according to ASTM E 330, as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified deflection limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
- F. Thermal Movements: Allow for thermal movements from ambient-and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- G. Light Spectrum Transmittance Characteristics: Provide a glazing system complying with the following requirements:
 - 1. Maximum Transmittance of Photosynthetically Active Radiation: Within the range of PAR 400 to 700 nm, but not less than 85 percent of total transmittance.
 - 2. Infrared Radiation (Wavelengths Less Than 3000 nm): Less than 5 percent of total transmittance.
 - 3. Ultraviolet Radiation (From 300 to 400 nm): Less than 25 percent of total transmittance.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:
 - 1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.24 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 - 2. Solar-Heat-Gain Coefficient (SHGC): Fixed glazing and framing areas shall have an SHGC of no greater than 0.41 as determined according to NFRC 200.
 - 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.

2.2 STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

- A. Structured-Polycarbonate-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with structured-polycarbonate panels.
1. Basis-of-Design Product:: Subject to compliance with requirements, provide the following product, or a comparable product of another listed manufacturer:
 - a. CPI Daylighting, Inc.; Quadwall System.
 2. Other Manufacturers: The products of the following manufacturers may have products comparable to the basis-of-design product. Products not complying with the requirements of this Section will not be considered:
 - a. Duo-Gard Industries Inc.
 - b. EXTECH/Exterior Technologies, Inc.

2.3 STRUCTURED-POLYCARBONATE PANELS

- A. Structured-Polycarbonate Panels: Translucent, extruded-polycarbonate sheet with multiwall cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.
- B. Panel Thickness: Nominal 1 inch.
- C. UV Resistance: On both surfaces.
- D. Color: Transparent, colorless.
- E. Panel Performance:
1. Plastic Self-Ignition Temperature: 650 deg F or more according to ASTM D 1929.
 2. Combustibility Classification: Class CC1 based on testing according to ASTM D 635.
 3. Smoke-Developed Index: 450 or less according to ASTM E 84, or 75 or less according to ASTM D 2843.
 4. Interior Finish Classification: Class A based on testing according to ASTM E 84.
 5. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D 2244, after outdoor weathering compliant with procedures in ASTM D 1435.
 - a. Outdoor Weathering Conditions: 60 months in Arizona or 120 months in a moderate North American climate.

2.4 ALUMINUM FRAMING SYSTEMS

- A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
1. Construction: One piece aluminum.
- B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
1. At closures, retaining caps, or battens, use ASTM A 193, 300 series stainless-steel screws.
 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
- E. Anchor Bolts: ASTM A 307, Grade A, galvanized steel.
- F. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- G. Exposed Flashing and Closures: Aluminum sheet not less than 0.050 inch thick, finished to match framing.
- H. Framing Gaskets: Manufacturer's standard gasket system with low-friction surface treatment designed specifically for retaining structured-polycarbonate panels.
- I. Frame-System Sealants: As recommended in writing by manufacturer.
- J. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

- A. Fabricate aluminum components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Internal guttering systems or other means to drain water passing through joints and moisture migrating within assembly to exterior.
- B. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
- C. Reinforce aluminum components as required to receive fastener threads.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 PREDEMOLITION EXAMINATION

- A. Before demolition of existing fiberglass sandwich panel assembly, visually inspect the existing greenhouse framing system and related components, including, but not limited to the following:
 - 1. Greenhouse framing members that will support new construction, including structural connections between members and connections to existing building framing.
 - 2. Metal flashings, trim, gutters, and drains shown to remain and be reused in new construction.
 - 3. Weatherstripping, gasketing, and sealants that will not be replaced in new construction.
 - 4. Existing construction that will receive new structured polycarbonate panels assembly components affecting structural support, stability, and weathertightness of new greenhouse envelope.
- B. Inspect greenhouse framing and related components for evidence of corrosion, field modifications such as cutting or drilling that could affect structural performance, finish deterioration, and other conditions that could affect the ability of the existing framing system to serve as a sound, stable, aesthetically acceptable support for the structured polycarbonate assembly roof and wall panel assemblies.
- C. Prepare a report complete with written observations, photographs, and recommendation for remediation of deteriorated elements.
 - 1. Base recommendations on experience with similar conditions.
 - 2. Submit report to Owner, with a copy to the Architect/Engineer.
- D. Schedule a meeting to be held approximately one week after submission of report to discuss type and extent of potential remediation work. Invite, Installer, Owner's Representative, and Architect/Engineer.

3.2 PREINSTALLATION EXAMINATION

- A. Immediately following removal of each portion of the existing fiberglass sandwich panel envelope assembly, and before beginning installation work of new structured-polycarbonate panel assembly, examine newly exposed framing, support work, flashing, and trim as indicated for predemolition examination. Determine whether removal work has uncovered additional deteriorated, damaged, unsuitable, and non-reusable elements; and immediately report those conditions to the Owner and Architect Engineer for review and consideration of appropriate remediation.
- B. In addition, examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
 - 1. Do not install damaged components.

2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 3. Rigidly secure nonmovement joints.
 4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install components plumb and true in alignment with established lines and elevations.
- D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Install components to drain water passing through joints and moisture migrating within assembly to exterior.
- E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
 2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

END OF SECTION 08 45 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for swinging doors.
2. Electrified door hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - 1) Organization: Prepare schedules in vertical format only. Schedules prepared in horizontal format are not acceptable and will be returned without review.
 - c. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Fastenings and other pertinent information.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) List of related door devices specified in other Sections for each door and frame.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For electrified door hardware, from the manufacturer.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect/Engineer, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- F. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Requirements for access control.
 5. Address for delivery of keys.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.7 COORDINATION

- A. Hardware Coordination, General: Coordinate templates for each hardware item specified for each door opening. Where locations of installed overhead stops and holders, door closers, or other hardware items conflict, provide alternative, compatible hardware items comparable in function and quality to the specified items.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated by Basis-of-Design products scheduled.
 - a. Provide Basis-of-Design products or comparable products by another listed manufacturer. If no other manufacturers are named, provide only the Basis-of-Design product.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:

1. Hager Companies (HAG)
2. IVES Hardware; an Ingersoll-Rand company. (IVS)
3. McKinney Products Company; Div. of ESSEX Industries, Inc. (MCK)
4. Stanley Commercial Hardware; Div. of The Stanley Works (STH)

2.3 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. Mortise Locks: Minimum 3/4-inch latchbolt throw.
- C. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- D. Lock Trim: As schedule as part of lockset.
- 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. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company. (CRH)
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company. (SGT)
 - c. Schlage Commercial Lock Division; an Ingersoll-Rand company. (SCH)

2.4 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Folger Adam Electric Door Controls; an ASSA ABLOY Group company. (FAC)
 - b. HES, Inc.; an ASSA ABLOY Group company. (HES)
 - c. Rutherford Controls Int'l. Corp. (RCI)
 - d. Schlage Commercial Lock Division; an Ingersoll-Rand company. (SCH)
 - e. Von Duprin; an Ingersoll-Rand company. (VDP)

2.5 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Adams Rite; an ASSA ABLOY Group company.
 - b. Door Controls International.
 - c. Ives; an Ingersoll-Rand company.(IVS

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Product: Match existing in building.
- B. Provide cylinders less final cores. All final cores, and keys, shall be furnished and installed by the WSU. Key Shop.

2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 - 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.
 - 2. Quantity:
 - a. Key blanks: Three.

2.8 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.

2.9 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations 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.
1. Accessories: Provide shoe supports where required by installation conditions. When used with stop-applied door gasketing, provide special shoe or stop spacer for arm to pass below stop and gasket.
 2. Coordinate hardware with door and frame details; furnish accessories, including drop plates, panel adapters, spacers and supports required for proper installation of door closers.
 3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.(CRH)
 - b. LCN Closers; an Ingersoll-Rand company.(LCN)
 - c. Norton Door Controls; an ASSA ABLOY Group company.(NOR)
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.(SGT)

2.10 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc.(ABH)
 - b. Glynn-Johnson; an Ingersoll-Rand company.(GJN)

2.11 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. National Guard Products.(NGP)
 - b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.(PEM)
 - c. Reese Enterprises, Inc.(REI)
 - d. Zero International.(ZER)

2.12 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Baldwin Hardware Corporation.(BHC)
 - b. IVES Hardware; an Ingersoll-Rand company.(IVS)
 - c. Rockwood Manufacturing Company.(RMC)

2.13 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-rated labels and as otherwise approved by Architect/Engineer.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - 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.

2.14 FINISHES

- A. Provide finishes complying with 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.
- 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 according to ANSI/SDI A250.6.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with ANSI/SDI A250.8 unless otherwise indicated or required to comply with governing regulations.
- 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 specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Furnish permanent cores to Owner for installation.
- E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect/Engineer.
 - 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

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. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 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 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 01

Single Door, New Interior

2	Ball Bearing Hinges	BB1168 (4.5" x 4.5") x NRP	652	HAG
1	Ball Bearing Anchor Hinge	AB7505 (5" x 4.5") x NRP	652	HAG
1	Classroom Lockset	L9070 x 17A	626	SCH
1	Cylinder	Match building standard	626	
1	Closer	4011	689	LCN
1	Concealed Overhead Stop	106S	630	GJN
1	Kickplate	8400 (10" x 1.5" LDW)	630	IVS
1 set	Smoke Gasketing	S88	CLR	PEM
1	Credential Reader Device	By Owner's Security Provider		

Door Hardware Set No. 02

Single Door, Existing Interior

1	Storeroom Lockset	L9080 x 17A	626	SCH
1	Cylinder	Reuse existing	626	
	Balance of Hardware	Existing to remain		

1. Note: Coordinate to verify new lockset will fit in existing mortise prep.

Door Hardware Set No. 03

Single Door, Existing Interior

1	Classroom Lockset	L9070 x 17A	626	SCH
1	Cylinder	Match building standard		
	Balance of Hardware	Existing to remain		

1. Note: Coordinate to verify new lockset will fit in existing mortise prep.

Door Hardware Set No. 04

Single Door, Existing Interior

1	Storeroom Lockset	L9080 x 17A	626	SCH
1	Cylinder	Match building standard	626	
1	Electric Strike	6210 (Fail Secure) x 24 VAC	630	VDP
1	Power Supply	PS861	N/A	VDP
1	Credential Reader Device	By Owner's Security Provider		
	Balance of Hardware	Existing to remain		

1. Coordinate to verify new lockset will fit in existing mortise prep.
2. Modify existing frame as required to suit new electric strike. Run wiring concealed in existing frame if practicable. If wiring cannot be run concealed in frame, provide new 1/2 inch EMT conduit between lock and power supply mounted above door.
3. Operation:
 - a. Presentation of valid credential to reader card to momentarily releases strike, allowing ingress. Ingress also available at all times with key.
 - b. Egress available at all times by lever.

Door Hardware Set No. 05

Pair Doors, New Interior

6	Ball Bearing Hinges	BB1279 (4.5" x 4.5") x NRP	652	HAG
1	Classroom Lockset	L9070 x 17A	626	SCH
1	Cylinder	Match building standard	626	
2	Flush Bolt (Top & Bot.)	FB457 XDP1	630	IVS
2	Closers	4011	689	LCN
1	Coordinator	COR 52 x FB 20	711	IVS
2	Concealed Overhead Stop	401S	630	GJN
Set	Smoke Gasketing	5050C	CLR	NGP
1	Astragal	By door supplier (if required for fire-rating)		

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SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Glass for doors.
 - 2. Glazing sealants and accessories.

1.2 ACTION SUBMITTALS

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

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.4 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AGC Glass Company North America.
 - 2. Cardinal Glass Industries.
 - 3. Guardian Industries Corp.; SunGuard.
 - 4. Oldcastle BuildingEnvelope™.
 - 5. Pilkington North America.
 - 6. PPG Industries, Inc.
 - 7. Viracon, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

- 1. GANA Publications: "Glazing Manual."

- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

- 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.
 - 3. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 GLAZING SEALANTS

- A. General:

- 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect/Engineer from manufacturer's full range.

- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2700 SilPruf LM.
 - c. Pecora Corporation; 890NST.
 - d. Sika Corporation; SikaSil WS-290.

- e. Tremco Incorporated; Spectrem 1.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

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.
- 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.

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. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

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.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

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SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For high-strength steel studs and runners, from ICC-ES.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:

- a. Minimum Base-Metal Thickness: 0.027 inch.
- b. Depth: As indicated on Drawings.

2. High-Strength Steel Studs and Runners: Specially formed framing members rolled from high-strength steel.

- a. Minimum Base-Metal Thickness: 0.019 inch rolled from steel having 65 ksi yield strength.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - 2. Deflection Track: Steel sheet top runner 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. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
 - 3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 4) Superior Metal Trim; Superior Flex Track System (SFT).
 - 5) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.033 inch.
- E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

2.3 SUSPENSION SYSTEMS

- A. Hanger Attachments to Concrete:
 - 1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to **[10]** <Insert number> times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension

system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. 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.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

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 C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

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

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. National Gypsum Company.
5. USG Corporation.

- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.

- B. Joint Tape for Interior Gypsum Board: Paper.

- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.

3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; [AC-20 FTR] [AIS-919].
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

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

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical surfaces unless otherwise indicated.
 - 2. Ceiling Type: Ceiling surfaces.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels 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.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. 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.
 - 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect/Engineer for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

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

- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view or concealed behind wall covering.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

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

END OF SECTION 09 29 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect/Engineer from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

- A. Basis of Design:: Subject to compliance with requirements, provide the following product or a comparable product by another listed manufacturer:
 - 1. United States Gypsum Company; Mars Clima Plus Healthcare
 - 2. Other Manufacturers: The following manufacturers may have comparable products that will be considered.
 - a. Armstrong World Industries, Inc.
 - b. CertainTeed Corporation.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular; with washable vinyl-film overlay.
 - 2. Pattern: E (lightly textured) and G (smooth).

- C. Color: White.
- D. LR: Not less than 0.85.
- E. NRC: Not less than 0.70.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 3/4 inch.
- I. Modular Size: As indicated on Drawings.
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

2.5 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. United States Gypsum Company.
- B. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 coating designation; with prefinished, cold-rolled, 15/16-inch-wide aluminum caps on flanges.

1. Structural Classification: Intermediate-duty system.
 2. Face Design: Flat, flush.
 3. Face Finish: Painted white.
- C. 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. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. 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, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

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

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

3.4 CLEANING

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

END OF SECTION 09 51 13

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.2 ACTION SUBMITTALS

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

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 20 linear feet.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. AB; American Biltrite.
 2. Armstrong World Industries, Inc.
 3. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 4. Flexco.
 5. Johnsonite; A Tarkett Company.
 6. Nora Systems, Inc.
 7. Roppe Corporation, USA.
 8. VPI Corporation.
- 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.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Corners: Job formed.
- G. Colors: As selected by Architect/Engineer from full range of industry colors.

2.2 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 3. Flexco.
 4. Johnsonite; A Tarkett Company.
 5. Musson Rubber Company.
 6. Roppe Corporation, USA.
- B. Description: Vinyl reducer strip for resilient flooring.
- C. Locations: Transition from vinyl tile to resinous flooring.
- D. Colors and Patterns: As selected by Architect/Engineer from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Do not install resilient products until they are the same temperature as the 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.
- C. 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. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. 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 exposed surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Vinyl composition floor tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

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 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.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.7 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 or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time 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 or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, 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 VINYL COMPOSITION FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Biltrite.
 2. Armstrong World Industries, Inc.
 3. Congoleum Corporation.
 4. Mannington Mills, Inc.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.
- F. Colors and Patterns: As selected by Architect/Engineer 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 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.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.

- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles. Lay tiles with grain running in one direction.
- 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. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 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 exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermal shock-resistant urethane resinous flooring system
2. Decorative resinous flooring system.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Material Certificates: For each resinous flooring component, from manufacturer.
- E. Material Test Reports: For each resinous flooring system.
- F. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Manufacturer Qualifications: Manufacturer shall directly employ a full-time, on-site project manager, for the duration of the resinous flooring work of the Project.
- C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect/Engineer.

- a. Include 48-inch length of integral cove base with inside and outside corner.
 2. Simulate finished lighting conditions for Architect/Engineer's review of mockups.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace resinous flooring systems that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated or comparable products by another listed manufacturer:
1. Stonhard, Inc.; specific component products as listed in other Part 2 Articles.
 2. Other Manufacturers:
 - a. BASF Construction Chemicals, Inc.; BASF Building Systems.
 - b. Sherwin-Williams Company; General Polymers.
 - c. Tennant Corporation.

2.2 CLIMATIC (THERMAL-SHOCK RESISTANT) URETHANE RESINOUS FLOORING

- A. Topping complying with the specified climatic system requirements and withstanding impact and abrasion from vehicle mover use. Topping shall have total system thickness of not less than 1/4-inch and including optional primers, four-component urethane chemistry topping and a two-component urethane finish coat. Finish shall be pinhole free. Provide profile aggregate as specified for slip resistance.
1. Products:
 - a. Stonhard; Stonclad UT
 - b. Rezstone "9725 UMC-SL 1/4 Urethane Modified Concrete with Broadcast and Alaphatic Urethane Finish
 - c. Sika Corporation, "Sika Industrial Flooring - Sikafloor"
 - d. The Sherwin-Williams Company; "FasTop 12M"
 2. Wearing Surface: Textured for slip resistance.
 3. Overall Dry-Film System Thickness: 3/16 inch, nominal.
 - a. Thickness indicated includes primers and aggregates and is not necessarily the sum of listed resinous components.
 4. Coefficient of Friction: 0.75 per ASTM D 2047.

2.3 DECORATIVE RESINOUS FLOORING SYSTEM

- A. Decorative Resinous Flooring System: Impact- and chemical-resistant decorative epoxy flooring system with broadcast quartz aggregate chips.
1. Basis of Design Flooring System Product: Dur-A-Flex, Inc.; Dur-A-Chip comprised of the component materials listed below.
 2. Primer: Dur-A-Glaze#4 WB epoxy resin.
 3. First Broadcast Coat: Dur-A-Gard OPF two-component epoxy resin.
 4. Second Broadcast Coat and Grout Coat: Dur-A-Glaze#4 and Water Clear, two-component epoxy resin and hardener.
 5. Decorative Aggregate: Colored macro or micro flake chips as required for selected color and pattern.
 6. Topcoat: Armor Top urethane hardener and grit.
- B. System Characteristics:
1. Color: Match Dur-A-Chip Cobblestone.
 2. Wearing Surface: Smooth texture
 3. Overall Dry-Film System Nominal Thickness: 40 mils.

2.4 ACCESSORIES

- A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 COATING APPLICATION, GENERAL

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes. Prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.
 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: 4 inches high.

3.3 APPLICATION OF HIGH-PERFORMANCE COATINGS

- A. Apply troweled mortar coat in a single application of thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness by sanding.
- B. Apply engineering fabric, saturant, mortar coat and topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.4 TERMINATIONS

- A. Chase edges to "lock" the coating system into the concrete substrate along lines of termination.
- B. Penetration Treatment: Lap and seal coating onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- C. Treat floor drains by chasing the coating to lock in place at point of termination.

3.5 JOINTS AND CRACKS

- A. Treat control joints to bridge potential cracks and to maintain monolithic protection.
- B. Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- C. Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.6 FIELD QUALITY CONTROL

- A. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
- B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.7 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 09 67 23

SECTION 09 72 00 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Hygienic wall coverings.

1.2 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. American Society for Testing Materials (ASTM):
 - 1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 2. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles, and Tubes

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide antimicrobial wall covering which has been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's current printed product literature.
- B. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories.
- C. Samples: Submit duplicate sample pieces of material in manufacturer's standard sample size.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data for installed products for inclusion in maintenance manuals.. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this Project.

1.7 DELIVERY, STORAGE & HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
- C. Store panels in temperature controlled environments, off the ground and flat. Pre-condition 24 hours in ambient temperatures similar to the prevailing operational conditions.

1.8 PROJECT CONDITIONS

- A. Maintain air temperature and structural base temperature at installation area between 65F (18C) and 80F (26C) for 48 hours before, during and 24 hours after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

- 1. ProTek Systems, Inc. www.proteksystem.com; WPAM-12

2.2 HYGIENIC WALL COVERINGS

- A. Antimicrobial Wall System:

- 1. Material: Alloy 5052-H32.063" aluminum sheet with antimicrobial powder coat finish.
- 2. Size: 4 by 10 feet
- 3. Joint Offsets: 1/2 inch.
- 4. Color: As selected by Owner from manufacturer's standard range.

2.3 ACCESSORIES

- A. Inside Corner Trim:

- 1. Material: Alloy 5052-H32.063" aluminum with antimicrobial powder coat finish.
- 2. Size: As required for a seamless installation.
- 3. 1/2 inch offset construction
- 4. Color: Choose from manufacturer's standard colors
- 5. Custom heights and angles available

- B. WPAM-12-OCG-50 Outside Corner Trim:

- 1. Material: Alloy 5052-H32.063" aluminum with antimicrobial powder coat finish.
- 2. Size: As required for a seamless installation.
- 3. 1/2 inch offset construction
- 4. Color: Choose from manufacturer's standard colors
- 5. Custom heights and angles available

C. Edge Bar / Top Cap:

1. Material: Alloy 6063-T52 aluminum flat bar with antimicrobial powder coat finish.
2. Size: As required for a seamless installation.
3. Profile: 1 by 1/8 inch
4. Color: Choose from manufacturer's standard colors
5. Custom profiles and lengths available

D. Mounting Method: Adhered, using ADH-50 construction adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. In presence of Installer, verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions:

1. Verify walls are smooth, level and finished with primer/sealer. Remove high points and fill low points using material approved by the panel manufacturer.
 - a. Check room using a 6 foot level to ensure all walls are flat, including corner conditions and door openings.
2. Verify surfaces are dry and free from substances that may contribute to adhesive bond failure.
 - a. Verify surfaces are clean and free from dust. The working environment must also be dust free.
 - b. Verify
3. Remove loose paint and conduct an adhesive bond test with paint.
4. Verify electrical switches and receptacles have been installed.
5. Verify plumbing rough-in is complete.
6. Verify door frames are in place.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Drill panels at pipe penetrations and slide over pipe tails. Drill holes 1/8 to 1/4 inch oversize and apply sealant around perimeter.

3.3 CLEANING

- A. Clean wall covering with diluted soap or detergent solution and follow an application of anti-static solution.

END OF SECTION 09 72 00

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SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation and field painting of exposed interior items and surfaces.
- B. Related Requirements:
 - 1. Section 09 91 53 "Electrostatically Applied Coating" for field-applied coatings on slotted channel framing shelf standards and brackets.

1.2 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
 - 2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
 - 3. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
 - 4. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
 - 5. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
 - 6. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
 - 7. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.
- B. Exposed: Surfaces of items that are exposed to view or exposed to weather in completed construction.
 - 1. Exposed-to-Weather: Located outside the building envelope; or otherwise in areas that will not be heated or not be protected from rain, snow, or other natural precipitation.
 - 2. Exposed-to-View: Surfaces observable in completed construction from all potentially occupiable locations inside and outside the structure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - a. Information on VOC content.

- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide draw-down samples applied on 8-by-10-inch cardboard panels. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. 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 PRODUCTS AND MANUFACTURERS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products of Sherwin-Williams Industries listed in Part 3 schedules, or approved substitute products of one of the following manufacturers.
 - 1. Benjamin Moore & Co.
 - 2. PPG Architectural Finishes, Inc.
 - 3. Sherwin-Williams Company (The).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As selected by Architect/Engineer from manufacturer's full range.

1. Paint surface-mounted mechanical and electrical system elements and materials to match the adjoining surface color and gloss, unless otherwise indicated.
2. Paint panel boards flat white.

2.3 INTERIOR PRIMERS

A. Interior Gypsum Board Primers: Factory-formulated latex-based primer for interior applications.

1. Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer B28W2600 Applied at a dry film thickness of not less than 1.5 mils DFT or greater to provide full coverage.

B. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.

1. Sherwin-Williams Kem Bond HS Universal Metal Primer B50 Series Applied at a dry film thickness of not less than 2.0 mils DFT or greater to provide full coverage.

2.4 INTERIOR FINISH COATS

A. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.

1. Sherwin-Williams ProMar 200 Zero VOC Interior Latex Eg-Shel B20-2600 Series Applied at a dry film thickness of not less than 1.7 mils DFT or greater to provide full coverage.

B. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.

1. Sherwin-Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 Series Applied at a dry film thickness of not less than 1.7 mils DFT or greater to provide full coverage.

- C. Interior Full Gloss Epoxy: Factory-formulated full-gloss epoxy enamel for interior application.
 - 1. Sherwin-Williams Pro Industrial Water Based Catalyzed Epoxy B73 Series. Applied a dry film thickness as recommended by manufacturer, or greater to provide full coverage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect/Engineer about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Repair of Existing Plaster and Gypsum Drywall Surfaces: Spackle and sand smooth minor surface imperfections including, but not necessarily limited to, anchor holes, dimples, and surface paper damage in existing drywall and plaster surfaces. Repair is limited to single imperfections of not more than 3 sq. in. in area.
- C. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. For coatings applied over previously painted surfaces, test application to check for lifting and other adhesion problems. Perform test in an inconspicuous area where practicable.

3. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- E. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.

7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- F. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- G. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect/Engineer.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 PAINT APPLICATIONS SCHEDULE

- A. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect/Engineer will select from standard colors and finishes available.
- B. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels.
 - c. Metal toilet enclosures.
 - d. Metal lockers.
 - e. Unit kitchens.
 - f. Elevator entrance doors and frames.
 - g. Elevator equipment.
 - h. Finished mechanical and electrical equipment.
 - i. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.

- d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- C. Painting Mechanical and Electrical Work: Limit painting of mechanical and electrical work to items exposed in equipment rooms, occupied spaces and outside the building perimeter as indicated.
- 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
 - 2. Mechanical items to be painted include, but are not limited to, the following:
 - a. Mechanical system elements and materials previously painted in existing construction.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Tanks that do not have factory-applied final finishes.
 - f. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - g. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 - h. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 3. Electrical items to be painted include, but are not limited to, the following:
 - a. Exposed electrical system elements and materials previously painted in existing construction.
 - b. Switchgear.
 - c. Panelboards.
 - d. Electrical equipment that is indicated to have a factory-primed finish for field painting.
 - e. Conduit, fittings, and boxes; except pre-finished equipment.

- D. Interior Paint Applications: Paint exposed interior surfaces, except where provisions of this Section or paint schedules indicate that a surface or material is not to be painted or finished.
1. Walls: Where walls are scheduled to receive a paint coating, exposed elements and surfaces to be painted include, but are not limited to, the following:
 - a. Wall mounted items previously painted in existing construction.
 - b. Columns, both engaged and free-standing within the scheduled area.
 - c. Handrails, including brackets and escutcheons.
 - d. Woodwork and standing and running wood trim, finished as scheduled.
 - e. Paneling, finished as scheduled.
 - f. Doors and door frames, finished as scheduled.
 - g. Windows frames, finished as scheduled.
 - h. Access panels.
 - i. Gypsum fasciae, soffits, and trim.
 - j. Mechanical Work.
 - k. Electrical Work.
 2. Ceilings: Where ceilings are scheduled to receive a paint coating, exposed elements and surfaces to be painted include, but are not limited to, the following:
 - a. Ceiling mounted items, previously painted in existing construction.
 - b. Access panels.
 - c. Gypsum fasciae, soffits and similar features.
 - d. Exposed portions of structural slabs.
 - e. Exposed portions mechanical Work.
 - f. Exposed portions of electrical Work.
 3. Life Safety Signage
 - a. Fire-Rated Interior Wall Identification: Use stenciled, painted letters to identify fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions. Comply with the recommendations of the Firestop Contractors International Association (FCIA) Manual of Practice. Comply with requirements of authorities having jurisdiction and the following:
 - 1) Locate identification in all accessible, concealed areas, including ceiling plenums and raised floor plenums.
 - 2) Repeat identification at intervals of 30 feet measured horizontally along the wall or partition surface.
 - 3) Use the words "FIRE AND/OR SMOKE BARRIER -PROTECT ALL OPENINGS" no less than 1/2-inch in height.

3.7 INTERIOR PAINT SYSTEMS SCHEDULE

- A. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:
1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - c. Application:
 - 1) All gypsum board surfaces except where an epoxy system is indicated.
 2. Full-Gloss Epoxy Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior full gloss epoxy enamel.
 - c. Application:
 - 1) Room 5155
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semigloss acrylic enamel.

END OF SECTION 09 91 00

SECTION 09 91 53 - ELECTROSTATICALLY APPLIED COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Electrostatic spray-applied coating for filed painting slotted channel framing used as shelf standards and brackets.
- B. Related Requirements:
 - 1. Section 09 91 00 "Painting" for general field painting.
 - 2. Section 12 35 53.13 "Metal Laboratory Casework."

1.2 ACTION SUBMITTALS

- A. Product Data: For coating materials, including descriptive data and recommendations for mixing, application, and curing.
- B. Samples for Verification: Two cards, not less than 3-inches by 5-inches, of actual paint sample of selected color. Provide additional card sets for each color.

1.3 QUALITY ASSURANCE

- A. Installer Requirements: Firm employing factory-trained applicators and using application equipment used complies with coating manufacturer's requirements.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to job site in new, original, and unopened containers bearing manufacturer's name, trade name, and label analysis. Store materials in protected area at a temperature not less than 50 F and in accordance with other manufacturer's instructions.

1.5 PROJECT CONDITIONS

- A. Apply coatings only when environmental temperature can be maintained above 50 deg. F. during application and drying period.
- B. Provide work areas free of excessive dust. and with illumination adequate to apply special coatings.

PART 2 - PRODUCTS

2.1 APPLICATOR

- A. Source Limitations: CASCOAT Electrostatic, Inc. or, subject to compliance with requirements, a comparable, approved substitute applicator.

2.2 MATERIALS

- A. General: Provide coatings specifically compounded by coating manufacturer for electrostatic spray application. Where primers are indicated or required, provide only primers that are approved by manufacturer for use with finish coating materials.
- B. Material Quality: Materials which do not display manufacturer's identification will not be acceptable.
- C. Mix, prepare, and store materials according to Manufacturer's latest printed instructions. Manually mix coating materials; power mixing devices are not permitted. Do not add thinner or other agents to coating materials.
- D. Coating Color: Gloss black

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to be coated and report any conditions that would adversely affect the appearance or performance of the coating systems and which cannot be put into an acceptable condition by specified preparation.
- B. Do not proceed with surface preparation and application until the surface is acceptable or authorization to proceed is given by the Owner.

3.2 PREPARATION

- A. Protect work of other trades and adjacent surfaces not scheduled to be coated. Prepare and clean in strict accordance with coating manufacturer's instructions.
- B. Sand, or chemically clean as appropriate, all abraded surfaces, corroded areas and other imperfections in surfaces to be coated. Fill or feather edges of sanded areas to produce for a smooth transition to bare metal.

3.3 APPLICATION

- A. Apply prime and finish materials in accordance with manufacturer's directions. Apply each material at not less than the manufacturer's recommended spreading rate. Use special equipment, applicators, and techniques recommended by manufacturer as best suited for the particular applications.

- B. Apply additional coats beyond scheduled requirements when undercoating, stains or other conditions show through final paint coat until the special coating is of uniform finish, color and appearance.

3.4 COATING SURFACES

- A. Prepare and apply coating to the following surfaces:
 - 1. Slotted Channel Framing Standards and Brackets:
 - a. Surfaces exposed to view in final construction, including exposed surfaces of standards, brackets, fasteners and anchors. Paint all surfaces of shelf support brackets, regardless of whether surface will be in contact with underside of shelf in final construction.

3.5 CLEANING

- A. Remove paint spatters from any adjoining surfaces. Repair any damage to coatings or surfaces caused by cleaning operations. Remove debris from job site and leave area clean.

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SECTION 11 71 02 - LABORATORY WASHING AND STERILIZING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Laboratory washing and sterilization equipment, including laboratory glassware and utensil washers, and steam sterilizers.
- B. Related Work:
 - 1. Section 22 05 00 "Common Work Results For Plumbing."
 - 2. Section 22 11 16 "Domestic Water Piping."
 - 3. Section 22 13 16 "Sanitary Waste And Vent Piping."
 - 4. Section 23 11 23 "Facility Natural-Gas Piping."
 - 5. Section 23 21 13 "Hydronic Piping."
 - 6. Section 26 05 00 "Common Work Results For Electrical."

1.2 DEFINITIONS

- A. Glassware and Utensil Washer: An automated washing unit that uses high-temperature water and detergent to clean and disinfect instruments and lab glassware. The washer shall be a free standing model.
- B. Steam Sterilizer: A machine used to sterilize instruments and equipment by subjecting them to high-pressure steam up to 275°F. Sterilizers are available in both cart-loading and counter-top models. They can be either freestanding or recessed, with single or double doors (pass-thru). Steam sterilizers are also known as autoclaves. More efficient models employ a vacuum pump to remove air from the chamber prior to a sterilization cycle, thus providing more efficient steam sterilization.

1.3 PERFORMANCE REQUIREMENTS

- A. Equipment shall have built-in monitoring for timed cycles, and control devices for temperature and pressure.
- B. Manufacturer safeguards must be provided with the equipment to protect the operator from harm during normal operation of the equipment.
- C. As needed in the application, provide a means of preventing accidental tampering with cycle times and parameters, via electric or physical safeguards.
- D. Provide water use reduction cycles and features where available. For instance, equipment utilizing steam should scavenge steam instead of wasting cold water to condition hot water/steam prior to entering drains.
- E. Provide energy use reduction cycles and features where available.

1.4 SUBMITTALS

- A. Manufacturer's Literature and Data: Include the following:
1. Illustrations and descriptions of laboratory washing, cleaning, filling, drying, sterilizing, and sanitizing equipment.
 2. Optional auxiliary equipment and controls.
 3. Catalog or model numbers for each component.
 4. Accessories and optional features which enhance equipment performance or operation.
 5. Utility requirements.
 6. Control wiring diagrams.
 7. Installation Manuals
- B. Shop Drawings: Show details of fabrication, installation, adjoining construction, coordination with mechanical and electrical work, anchorage, and other work required for complete installation.
- C. Field Test Reports: Provide certification reports from accredited service technicians or installers.

1.5 QUALITY CONTROL

- A. Mechanical, electrical, and associated systems shall be safe, reliable, efficient, durable, easily and safely operable, maintainable, and accessible. Such equipment shall be appropriate protected from failures due to moist environments, as appropriate to use.
- B. Standard Products: Material and equipment shall be the standard products of the selected manufacturer, and they should be regularly engaged in the manufacture of such products for at least 3 years. The design, model and size of each item shall have been in satisfactory and efficient operation in a similar installation environment (eg laboratory setting) on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work stations, shall be the current generation of technology and basic design at the time of purchase, which has a proven satisfactory service record of at least three years.
- C. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
- D. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- E. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- F. Installer Qualifications: For sterilizers, installer is authorized representative of sterilizer manufacturer and employs factory-trained personnel to install sterilizers. For other equipment, installer shall be licensed as may be necessary by regulatory organizations. For all equipment, installer shall meet the qualifications of ANSI/ASSE Standard 6010.
- G. Steam Sterilizers: Comply with the most current version of ANSI/AAMI ST8 or ST55.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute/Association for the Advancement of Medical Instrumentation (ANSI/AAMI): ST79-2006 Comprehensive guide to steam sterilization
- C. Underwriters Laboratories): UL Standard 61010-1

1.7 WARRANTY

- A. The warranty period shall be no less than three years for all equipment.

1.8 GUARANTEE PERIOD SERVICES

- A. Engage factory-trained authorized manufacturers' representatives to perform maintenance service on equipment during guarantee period.
 - 1. Maintenance Service:
 - a. Inspection of equipment at regularly scheduled intervals as defined by the manufacturer.
 - b. Testing, cleaning, adjusting, repairing, and furnishing and installing replacement components as required to maintain equipment in reliable working condition.
 - 2. Maintenance service does not include cleaning, adjusting, repairing, furnishing and installing replacement components required because of improper use.

PART 2 - PRODUCTS

2.1 LABORATORY GLASSWARE AND UTENSIL WASHER

- A. Cabinet Model: Fully programmable high performance laboratory glassware washer shall be capable of direct injection washing of narrow-necked glassware (with proper inserts) and providing a heated DI water final rinse cycle, detergent, neutralizer, rinse aid dosing systems, and accepts a wide variety of baskets and inserts for various laboratory glassware types. The washer shall be approximately 80 inches high by 42 inches wide by 33 inches deep.
 - 1. Chamber size: Interior useable space approximately: 25-1/8" high by 26" wide by 26" deep.
 - 2. Mechanical Construction: Mechanical construction shall consist of the pump, piping, spraying and frame systems. The washers shall be designed and built as a free standing with the pump and piping systems integral to the cabinet assembly with single point utility connections. The following sections describe these major mechanical systems.
 - a. The wash chamber and sump shall be made of 304L Stainless Steel and insulated with 1 inch thick fiberglass insulation with a vapor barrier covering the top, sides and bottom. Provide an interior light in the ceiling of the wash chamber. The bottom of the wash chamber shall be equipped with a 304L Stainless Steel debris

- screen to prevent large debris from entering the piping system. The sump shall be equipped with 4.9 kW electric heaters and two water level float switches.
- b. The automatic vertical sliding chamber door is insulated, airtight and watertight to ensure process integrity. A safety edge sensor shall prevent the door from closing if an obstruction is detected.
 - c. All components of the wash/rinse system including moving spray arms, piping and valves shall be constructed of 304L stainless steel. A stainless steel dual speed pump shall deliver all treatments under pressure. The pump shall be equipped with mechanical seal, totally enclosed motor frame, magnetic starter, overload protection and sealed bearings.
 - d. The washer frame, external cabinet and all fasteners shall be made of either type 201 or 304 stainless steel with #2B or #4 finish. The frame shall be equipped with adjustable leveling legs. Provide service access panels as necessary to provide access to all components including piping, valves and electrical components.
 - e. The unit shall be equipped with brass cold water line used for Drain Discharge Cool Down.
 - f. The washer shall include two manifold connectors at the bottom of the chamber that automatically connect to the removable accessory headers. The rotary spray arm shall be located at the top of the wash chamber to ensure efficient coverage.
 - g. Two peristaltic pumps shall automatically dispense a selected amount of liquid chemicals into the chamber sump during the desired treatment. Provide tubing, wiring and low level sensors for remote location of chemical containers.
 - h. The washer shall be furnished with a SMART Filling System to reduce water consumption by automatically selecting the minimal quantity of water that is required based on the selection of accessories.
 - i. Provide dry electrical contacts that can be used to provide a signal and energize an external alarm.
3. Electric System: The Electrical System shall include the following components
- a. Wiring: The electrical wiring shall be performed as per the following:
 - 1) Each wire end connected to a terminal is labeled using plastic strip or tag with plastic protection.
 - 2) Low level instrument signals are routed separately from power wiring where technically possible.
 - 3) All devices such as starters, power supply, relays, etc., are identified with adhesive labels.
 - 4) All operator accessible switch and selectors are labeled with clear pictograms.
 - 5) Entire electrical system is protected with motor starter protector (MSP) and breakers.
 - b. Electrical Box and Control Panel: The electrical box shall include both high and low voltage sections. The control panel shall be incorporated with the electrical box on the soiled side, and shall typically contain the following major components:
 - 1) Cabinet is fabricated from AISI 304 stainless steel with a lockable front panel.
 - 2) Electrical box design is made according to NEMA 13 (IP65) standard
 - 3) Pump motor contactor.
 - 4) Drying contactor.
 - 5) Pump motor MSP.
 - 6) Drying MSP.

- 7) Control relay, DPDT and SPDT (outputs and customer monitoring purposes).
- 8) 3 X Module 8 digital inputs.
- 9) 4 X Module 8 digital outputs.
- 10) 1 X Module 4 analog inputs module.
- 11) Processor module includes communication for printer
- 12) Battery back-up.
- 13) Disconnect switch.
- 14) Auxiliary contact
- 15) Ethernet switch
- 16) Power supply
- 17) Audible Alarm
- 18) Panel view
- 19) Contactors for electrical heaters

4. Control System:

a. System Description:

- 1) Standard, commercially available Programmable Logic Controller (PLC) shall be utilized in the Reliance 400XLS Washer. The control system shall consist of the Allen-Bradley CompactLogix PLC with an Allen-Bradley Interface on the load side.
- 2) The electrical and mechanical designs of the unit, relative to PLC functions, are in accordance with general fail-safe principles. This principle ensures that, in a situation where a mechanical failure of a component or loop fault would occur, the washer would be automatically controlled to a safe state by the PLC.

b. Hardware: The control system shall consist of the following main components and is properly installed to avoid electrical and electromagnetic disturbances:

- 1) A-B CompactLogix CPU 1769-L32E
- 2) A-B CompactLogix 1734-IB8 digital input module
- 3) A-B CompactLogix 1734-OB8 digital output module
- 4) A-B PanelView Plus 600 Color Touch Panel
- 5) Ethernet port for interfacing with ProConnect® Remote Monitoring Services.
- 6) RS-232 port for coupon printer system.
- 7) RTD module for recirculation temperature transmitter, final rinse tank temperature transmitter, chamber drying temperature transmitter
- 8) 4-point analog input module for pressure pump pressure transmitter, final rinse conductivity signal and chemical injection conductivity signal. Analog signals are 4-20 mA.

c. Software:

- 1) The control system software breaks down into the following elements:
 - a) CPU application program
 - b) Operator interface application program
- 2) CPU Application Program

- a) Allen-Bradley RS Logix 5000 shall be used in the development of the CPU application program that is based on relay ladder logic programming.
 - b) The CPU application program is divided into several software module groups to provide fully structured software.
 - c) Operator Application Program
 - d) Factory Talk View Studio (Machine Edition) shall be used to configure the screens of the operator interface application program.
- 3) Software features:
- a) Temperature unit is selectable between Fahrenheit and Celsius.
 - b) Time format is a.m. or 24 h, Date format is in YYYY/MM/DD - MM/DD/YYYY -DD/MM/YYYY.
 - c) Pressure unit is selectable between Psi, Bar and kPa.
 - d) Operator interface is offered in English as a standard.
 - e) A cycle/day count recall system reminds operator when it is time for a complete preventive maintenance check.
 - f) Washer can be shut down to reduce energy consumption when unit is in idle mode or be programmed to shut down automatically after completion of a cycle that is in process.
 - g) Total cycle remaining time is constantly displayed on the operator interface.
 - h) A visual and audible alarm indicates cycle completion. The alarm can be programmed to automatically shut off after a pre-determined period of time.
 - i) Control includes Service Mode feature, to run inputs/outputs and other preventive maintenance tests to facilitate troubleshooting.
 - j) Built-in service diagnostic program to permit system calibration and verification of component operation
- d. Security (Password Protection): Cycle programming shall be restricted by User privileges to ensure process integrity. Treatment times, water temperatures and other key process parameters such as chemical injection rate shall be programmable, and cycle may be locked in by the supervisor. Each program may be reviewed. Provide the following three access levels:
- 1) Operator level: Allows the operator to select preprogrammed cycles, start the cycle, view cycle parameters and print reports.
 - 2) Supervisor level: Allows the operator to select the cycle, start the cycle, view cycle parameters, print reports, calibrate instruments, and configure cycle parameters.
 - 3) Service level: Allows the operator or service personnel to select the cycle, start the cycle, view cycle parameters, print reports, calibrate instruments, activate/deactivate inputs and outputs and change the passwords for the other levels.
- e. Alarms: Alarms are designed to identify anomalies and deviations within the system. Active alarms will interrupt the washing process by causing the PLC to stop the sequence and place the system in Stand-by Mode. In a situation where an alarm is active the control system automatically displays it on the operator interface via alarm pop up screen. All active alarms will remain on the operator interface alarm pop up screen until the situation has been appropriately acknowledged, resolved and reset. Up to 38 alarms may be shown on the operator interface. Alarm conditions are communicated to the operator by:

- 1) Text visually displayed on the alarm banner screen, until the alarm is acknowledged.
 - 2) Audible alarm (Buzzer) is active until the alarm-acknowledged button is pressed.
 - 3) Common alarm relay output is provided for customer remote monitoring purpose
 - 4) Alarms are acknowledged and reset by pressing the alarm-acknowledged button on the operator interface.
 - f. Interlocks:
 - 1) A safety door switch shall prevent a cycle from starting if door is not fully closed, and also stops washer operation if a door is opened during a cycle. To prevent cross-contamination, clean side door shall not open before the cycle is successfully completed
5. Operation:
 - a. Items to be cleaned are placed over the appropriate wash accessories, which are manually pushed in the chamber, automatically coupling with the manifolded solution transfer system. The operator closes the door, selects a cycle and initiates it by pressing the START CYCLE touch pad on the operator interface touch screen.
 - b. The Reliance 400XLS Glassware Washer features 10 programmable cycles. Each cycle can be programmed to include up to 18 separate treatments. Possible standard treatments include:
 - 1) up to two pre-wash
 - 2) up to three wash
 - 3) up to three rinse
 - 4) up to nine pure water rinse
 - 5) drying
 - 6) Once a cycle is selected, the washer automatically processes the load through the programmed treatments.
6. Factory Preset Cycles:
 - a. The washer is programmed with five factory-set processing cycles:
 - 1) EXTRACare
 - 2) ENVIROCare
 - 3) PLASTIC
 - 4) STANDARD
 - 5) RINSECare
 - 6) A DESCALER cycle (considered 11th cycle) is also pre-programmed to enable routine descaling procedure.
 - 7) All factory-set cycles can be modified by an authorized operator to create complete new wash programs.
7. Typical Process Phase Description:
 - a. Pre-Wash: Load is sprayed with recirculated water at the selected temperature (hot or optional cold) for a selected amount of time (0-15 minutes). On completion of treatment, water is sent to drain.

- b. Wash: Load is sprayed with recirculated solution at the selected temperature (optional cold or heated up to 203°F for a selected amount of time (0-15 minutes). A controlled amount of chemical detergent is automatically added to the chamber sump at beginning of treatment. If heated water is selected, treatment will not start until selected temperature is reached. On completion of treatment, solution is sent to drain.
 - c. Rinse: Load is sprayed with recirculated water at the selected temperature (optional cold, hot or heated, in the sump, to 203°F for a selected amount of time (0-15 minutes). If heated water is selected, treatment will not start until selected temperature is reached. On completion of treatment, water is sent to drain.
 - d. Pure Water (DI) Rinse: Load is sprayed with recirculated water at the selected temperature to 203°F for a selected amount of time (0-15 minutes). On completion of treatment, water is either sent to drain or retained for use in the first treatment of next cycle.
 - e. Drying: HEPA filtered heated air is circulated through the piping, spindles, load items and chamber for the selected time (0 to 30 minutes). Temperature can be set to a high of approximately 240°F for regular glassware or to heat sensitive approximately 180°F for plastic items. If SMART drying is selected, drying time will automatically adjust itself according to the size of the load.
 - f. Cold water selection for the cycles is possible.
8. Utility Connections:
- a. The following typical utility connections are required for operation of the equipment. Please refer to the appropriate equipment and installation drawings for specific capacities and additional installation requirements.
 - 1) -Hot Water: 1/2" NPT
 - 2) -Cold Water: 1/2" NPT
 - 3) -Pure Water (DI): 1/2" NPT
 - 4) -Air: 1/8" NPT
 - 5) -Vent: 3" OD
 - 6) -Drain: 1-1/2" NPT
 - 7) -Electricity: 1" conduit size, 208 V, 60 Hz, 3-Phase, 30 Amp

2.2 LABORATORY STEAM STERILIZER

- A. Cabinet Model: Free standing Sterilizers using steam under pressure as the sterilizing agent; designed for sterilization of certain materials used in laboratories and research facilities. Sterilizer in room 3130 shall be approximately 75" high by 30" wide by 45" deep, and in room 5132 shall be 75" high by 54" wide by 58" deep.
 - 1. Chamber Details: The size shall be 26" x 37-1/2" x 36" for Lab 250 model, and 20" x 20" x 38" for Century Medium model. The chamber pressure shall be up to 45 PSIG, and chamber temperature between 230 and 275 degree F.
 - a. The gravity type configuration shall be designed for sterilization of nonporous heat and moisture stable goods for sterilization of liquids and media in borosilicate glass containers with vented enclosures, and decontamination of supplies after laboratory procedures, and shall be equipped with gravity and liquid cycles.
 - b. The prevacuum type configuration shall be designed for sterilization of porous and nonporous heat and moisture stable goods for sterilization of liquids and media in borosilicate glass containers with vented enclosures, and decontamination of

supplies after laboratory procedures, and shall be equipped with gravity, liquid, leak test, and daily air removal test cycles.

2. Mechanical Construction:

- a. Shell Assembly: Two Type 316L stainless steel shells, welded one within the other, to form the sterilizer vessel.
 - 1) End Frame: Type 316L stainless steel, welded to door end.
 - 2) Single door chamber back: Type 316L stainless steel formed head, welded to back of chamber.
 - 3) Vessel: ASME rated at 50 psig (Lab 250) and 45 psig (Century Medium).
 - 4) Baffle: Shield steam-supply opening inside chamber by a Type 316L stainless steel baffle.
- b. Chamber Door Type 316L stainless steel; insulated.
 - 1) Door Seal: Steam activated; construct from long-life rubber compound.
 - 2) Hinged Door with Manual operation.
- c. Insulation: One inch thick, fiberglass insulation sleeve, sealed and held in place with Velcro closures. Insulation to be asbestos-free, silicone impregnated, oil-and water-resistant fiberglass.
- d. Steam Piping: Construct of brass; include steam strainer, shut off valve, and brass pressure regulator.
- e. Pipe, valve, and trap sterilizer to receive building supplied steam.
- f. Piping: All piping and electrical connections to terminate within the confines of the sterilizer.
 - 1) Solenoid Valves: Locate in manifold with DIN Connectors.
 - 2) Manual Shutoff Valves: Pressure rated at 125 psig for saturated steam. Valve handles to be low-heat conducting.
- g. Support sterilizer on height-adjustable carbon steel stand, shop-coated for corrosion protection.
- h. Provide synthetic r

3. Control System:

- a. System Description
 - 1) Microcomputer control system that monitors and controls all phases of each sterilizing cycle.
 - a) Programmed with eight factory default cycles on LAB 250 model , and six factory default cycles on Century Medium model.
 - b) Adjustable cycle values and operating features.
 - c) Touch screen, vacuum fluorescent displays.
 - 2) Operator Interface Control Panel: Provide control panel located on operating (load or non-sterile) end of sterilizer, behind front cabinet service panel above the chamber.
 - a) Touch-sensitive Screen, graphics display graphics display.

4. Internal Battery (Century Medium): To back-up all cycle memory for up to ten years. If a power disruption occurs during a cycle, the battery permits completion of cycle once power is restored.
5. Non-volatile memory (Lab 250): Permanently stores cycle memory. If a power disruption occurs during a cycle, the cycle resumes once power is restored.
 - a. Cycle Descriptions: Sterilizers shall be factory programmed with the following cycles:
 - 1) Gravity Cycle: Provided on gravity and pre-vacuum sterilizers for the sterilization of heat-and moisture-stable goods at 212-285°F, and decontamination of bagged laboratory wastes. Gravity cycle utilizes the gravity air-displacement principle.
 - 2) Liquid Cycle: Provided on gravity and prevacuum sterilizers for the sterilization of liquids and media in vented borosilicate glass or metal containers at 212-254°F. Liquid cycle utilizes the optimal solution cooling feature, during exhaust (cooling) phase, to control the exhaust rate.
 - 3) Prevacuum Cycle: Provided on prevacuum sterilizers for the efficient, high-volume sterilization of porous, heat-and moisture-stable materials at 250-285°F. Prevacuum cycle utilizes a mechanical air-evacuation system.
 - 4) Leak Test Cycle: Provided on prevacuum sterilizers for verification of door seal and piping system integrity. Cycle parameters are preprogrammed and fixed. The acceptable maximum leak rate is 1 mm Hg/min over a 10-minute period following a fixed stabilization time.
 - 5) Daily Air Removal Test (DART): Provided on prevacuum sterilizers for verification of effective removal of residual air in the chamber and load during testing. Test cycle determines if even and rapid steam penetration into test load has occurred. Cycle parameters are preprogrammed and fixed.
6. Utility Connections:
 - a. The following typical utility connections are required for operation of the equipment. Please refer to the appropriate equipment and installation drawings for specific capacities and additional installation requirements.
 - 1) Steam: 1/2" NPT (Lab 250 model) and 1" NPT (Century Medium)
 - 2) Cold Water: 1" NPT
 - 3) Drain: 1-1/2" ODT (Lab 250 model) and 2" ODT (Century Medium)
 - 4) Power:
 - a) Controls -120V, 60 Hz, 1-Phase, 3 Amp (Lab 250)
 - b) Controls – 120V, 60 Hz, 1Phase, 3 Amp (Century Medium)
 - c) Vacuum Pump – 208V, 60 Hz, 3-Phase, 8 Amp (Century Medium)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with manufacturer's documented instructions.

- B. Coordinate installation with related mechanical, plumbing and electrical work. Provide cutouts and openings for mechanical, plumbing and electrical work as indicated or as required by trades involved.

3.2 TESTING AND CERTIFICATIONS

- A. Field test installed equipment after water and steam systems are pressurized for proper operation.
 - 1. Operate each unit for six hours through repeated full cycles. During and after testing, there shall be no evidence of leaks, overheating, electrical failure, or other symptoms of failure.
 - 2. For units that fail testing, make adjustments and corrections to installation, or replace equipment, and repeat tests until equipment complies with requirements.
- B. Where applicable, installer shall provide certificate of compliance and/or documented cycle records validating the activation and ready-for-use status of the equipment.

3.3 PROTECTING AND CLEANING

- A. Protect equipment from dirt, water, and chemical or mechanical injury during storage, installation, and throughout the duration of the construction period.
- B. At the completion of work, clean equipment as required to produce ready-for-use condition.

3.4 DEMONSTRATION AND TRAINING:

- A. Instruct personnel and transmit operating instructions.
- B. Training must be provided by the manufacturer, or manufacturer certified instructors.
- C. Orientation and Training on all equipment to be provided to a minimum of two owner designated personnel per equipment item/system and shall certify their operational competency.

END OF SECTION 11 71 02

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SECTION 12 35 53.13 - METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal laboratory casework.
2. Utility-space framing at backs of base cabinets.
3. Filler and closure panels.
4. Laboratory countertops.
5. Tables.
6. Shelves.
7. Laboratory sinks.
8. Laboratory accessories.
9. Water, laboratory gas, and electrical service fittings.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 09 22 16 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.
3. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to metal laboratory casework.
4. Section 09 91 53 "Electrostatically Applied Coating" for field painting of slotted channel framing used for shelf standards and brackets.

1.2 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
- B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, and attachment details.
 1. Indicate types and sizes of cabinets.
 2. Indicate locations of hardware and keying of locks.
 3. Indicate locations and types of service fittings.
 4. Indicate locations of blocking and reinforcements required for installing laboratory casework.
 5. Include details of utility spaces showing supports for conduits and piping.

6. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
7. Include coordinated dimensions for laboratory equipment specified in other Sections.

- C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.
- D. Samples for Verification: For each type of cabinet finish and each type of countertop material, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 M.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CIF Laboratory Solutions.
 - 2. Kewaunee Scientific Corporation.
 - 3. Mott Manufacturing Ltd.
- B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered. See Section 016000 "Product Requirements."

2.2 CASEWORK, GENERAL

- A. Casework Product Standard: Comply with SEFA 8 M, "Laboratory Grade Metal Casework."
- 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 METAL CABINET AND TABLE MATERIALS

- A. Metal: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.
- B. Nominal Metal Thickness:
 - 1. Sides, Ends, Fixed Backs, Bottoms, Tops, Soffits, and Items Not Otherwise Indicated: 0.048 inch. Except for flammable liquid storage cabinets, bottoms may be 0.036 inch if reinforced.
 - 2. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.036 inch except 0.048 inch for back panels and doors of flammable liquid storage cabinets and for unreinforced shelves more than 36 inches long.
 - 3. Intermediate Horizontal Rails, Table Aprons and Cross Rails, Center Posts, and Top Gussets: 0.060 inch.
 - 4. Drawer Runners, Sink Supports, and Hinge Reinforcements: 0.075 inch.
 - 5. Leveling and Corner Gussets: 0.105 inch.

2.4 AUXILIARY CABINET MATERIALS

- A. Glass for Glazed Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.5 COUNTERTOP TABLETOP SHELF AND SINK MATERIALS

- A. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, nonspecular finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durcon Incorporated.
 - b. Prime Industries, Inc.
 2. Physical Properties:
 - a. Flexural Strength: Not less than 10,000 psi.
 - b. Modulus of Elasticity: Not less than 2,000,000 psi.
 - c. Hardness (Rockwell M): Not less than 100.
 - d. Water Absorption (24 Hours): Not more than 0.02 percent.
 - e. Heat Distortion Point: Not less than 260 deg F.
 3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
 - a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
 - b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).
 4. Color: Black.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316L.

2.6 METAL CABINETS AND TABLES

- A. Fabrication: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt-and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.
- B. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.
- C. Glazed Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels or gasket material.
- D. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.
- E. Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Provide drawers with rubber bumpers, polymer roller slides, and positive stops to prevent metal-to-metal contact or accidental removal.

- F. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.
- G. Toe Space: Fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.
- H. Tables: Welded tubing legs, not less than 2 inches square with channel stretchers as needed to comply with product standard. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to table aprons. Provide leveling device welded to bottom of each leg.
 - 1. Leg Shoes: Black vinyl or rubber, open-bottom, slip-on type.
- I. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.
 - 1. Provide base cabinets with removable backs for access to utility space.
- J. Utility-Space Framing: Steel framing units consisting of two steel slotted channels complying with MFMA-4, not less than 1-5/8 inches square by 0.105-inch nominal thickness, that are connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch steel flat bars. Framing units may be made by welding specified channel material into rectangular frames instead of using U-shaped brackets.
- K. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets and with hemmed or flanged edges unless otherwise indicated.
 - 1. Provide knee-space panels (modesty panels) at spaces between base cabinets, where where space is not otherwise closed. Fabricate from back-to-back panels or of hollow construction to eliminate exposed hemmed or flanged edges.
 - 2. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
 - 3. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.

2.7 METAL CABINET FINISH

- A. General: Prepare, treat, and finish welded assemblies after assembling. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: After assembly, clean surfaces of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply laboratory casework manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 M. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
 - 2. Colors for Metal Laboratory Casework Finish: As indicated by manufacturer's designations match CIF Laboratory Solutions color "Light Neutral."

2.8 HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Stainless-steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two for doors 48 inches high or less and three for doors more than 48 inches high.
- C. Hinged Door and Drawer Pulls: Solid-aluminum, stainless-steel, or chrome-plated-brass, back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
 - 1. Design: Rectangular loop pulls with rounded corners.
 - 2. Overall Size: 1-1/4 by 4-1/2 inches.
- D. Door Catches: Nylon-roller spring catches. Provide two catches on doors more than 48 inches high.
- E. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
 - 1. Provide Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
 - 2. Provide Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
 - 3. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full-overtravel-extension, ball-bearing type.
- F. Locks: Cam or half-mortise type with five-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281, Type E07111, or Type E07021.
 - 1. Provide a minimum of two keys per lock and two master keys.
 - 2. Provide on all drawers and doors.
 - 3. Keying: Key locks alike within each room; key each room separately.
 - 4. Master Key System: Key all locks to be operable by master key.

2.9 COUNTERTOPS, TABLETOPS , SHELVES AND SINKS

- A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside 1/2 inch from edge.
- B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect/Engineer.
 - 1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2, unless otherwise indicated.
 - 2. Overflows: Where indicated, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches less than sink depth. Provide in same material as strainer.
- C. Epoxy Countertops Tabletops and Sinks:
 - 1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and butt joints assembled with epoxy adhesive and concealed metal splines.

- a. Countertop Configuration: Flat, 1 inch thick, with rounded edge and corners, and with drip groove and integral coved or applied backsplash.
 2. Tabletop Fabrication:
 - a. Tabletop Configuration: Flat, 1 inch thick, with rounded edge and corners, and with drip groove at perimeter.
 3. Sink Fabrication: Molded in one piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch minimum thickness.
 - a. Provide with polypropylene strainers and tailpieces.
 - b. Provide sinks for drop-in installation with 1/4-inch-thick lip around perimeter of sink.
 - c. Provide manufacturer's recommended adjustable support system for table-and cabinet-type installations.
- D. Stainless-Steel Countertops: Made from stainless-steel sheet, not less than 0.062-inch nominal thickness, with No. 4 satin finish.
1. Extend top down 1 inch at edges with a 1/2-inch return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
 2. Form backsplash coved to and integral with top surface.
 3. Provide raised (marine) edge around perimeter of countertops containing sinks.
 4. Factory punch holes for service fittings.
 5. Reinforce underside of countertop with channels, or use thicker metal sheet where necessary to ensure rigidity without deflection.
 6. Weld shop-made joints.
 7. Where field-made joints are required, provide hairline butt joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
 8. Where stainless-steel sinks occur in stainless-steel countertops, factory weld into one integral unit.
 9. After fabricating and welding, grind surfaces smooth, and polish as needed to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
- E. Stainless-Steel Sinks: Made from stainless-steel sheet, not less than 0.050-inch nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch radius. Slope sink bottoms to outlet. Provide double-wall construction for sink partitions, with top edge rounded to at least 1/2-inch diameter. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth, and polish as needed to produce uniform finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
1. Factory punch holes for fittings.
 2. Provide with stainless-steel strainers and tailpieces.
 3. Apply 1/8-inch-thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

2.10 LABORATORY ACCESSORIES

- A. Shelves: Provide as indicated, fabricated from 1-inch thick epoxy, to match countertops.

B. Shelf Standards and Brackets:

1. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - a. Size of Channels: 1-5/8 by 13/16 inches.
 - b. Material, Size and Thickness: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel and finished to match adjacent wall color.
2. Brackets: Slotted channel framing manufacturer's standard angle shelf bracket with single leg diagonal brace, sized to support shelf with no extension beyond shelf edge and leaving not more than 1 inch of shelf depth supported. Material and finish to match slotted channel.
3. Field Painting: Painting shelf support brackets and standards is included in Section 09 91 53 "Electrostatically Applied Coating."

C. Pegboards: Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

2.11 WATER AND LABORATORY GAS SERVICE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Broen A/S.
 2. Chicago Faucets; Geberit Company.
 3. Watersaver Company, Inc.
 4. WaterSaver Faucet Co.
- B. Service Fittings: Provide units that comply with SEFA 7, "Laboratory and Hospital Fixtures - Recommended Practices." Provide fittings complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
 1. Provide units that comply with "Vandal-Resistant Faucets and Fixtures" recommendations in SEFA 7.
- C. Materials: Fabricated from cast or forged red brass unless otherwise indicated.
- D. Finish: Chromium plated.
- E. Water Valves and Faucets: Provide units complying with ASME A112.18.1, with renewable seats, designed for working pressure up to 80 psig.
 1. Fitting Type: Swing-spout mixing faucet.
 2. Outlet: Vacuum breaker and removable serrated outlet.
 3. Mounting: Deck mounted.
 4. Vacuum Breakers: Provide ASSE 1035 vacuum breakers on water fittings with serrated outlets.
 5. Aerators: Provide aerators on water fittings that do not have serrated outlets.

- F. Ground-Key Cocks: Tapered core and handle of one-piece forged brass, ground and lapped, and held in place under constant spring pressure. Provide units designed for working pressure up to 40 psig, with serrated outlets.
1. Service: Gas (fuel gas).
 2. Fitting Type: Line mounted.
 3. Outlets: Two, at 90 degrees.
 4. Outlet Type: Straight.
 5. Valve Type: Ground-key cock.
- G. Hand of Fittings: Furnish right-hand fittings unless fitting designation is followed by "L."
- H. Remote-Control Valves: Provide needle valves, straight-through or angle type as indicated for fume hoods and where indicated.
- I. Handles: Provide three-or four-arm, forged-brass handles for valves unless otherwise indicated.
1. Provide lever-type handles for ground-key cocks. Lever handle aligns with outlet when valve is closed and is perpendicular to outlet when valve is fully open.
 2. Provide lever-type handles for ball valves unless otherwise indicated. Lever handle aligns with outlet when valve is closed and is perpendicular to outlet when valve is fully open.
- J. Service-Outlet Identification: Provide color-coded plastic discs with embossed identification, secured to each service-fitting handle to be tamper resistant. Comply with SEFA 7 for colors and embossed identification.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION OF CABINETS

- A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- F. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where indicated on Shop Drawings.
- B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
 - 1. Use concealed clamping devices for field-made joints in plastic-laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.
- C. Fastening:
 - 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
 - 2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
 - 3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch, and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide required holes and cutouts for service fittings.
- E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
- F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- G. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.3.
- B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table-and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive, and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.6 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices.
- B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink-and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.7 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect/Engineer.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION 12 35 53.13

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SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. Hangers and Supports:
 - a. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - b. Welding certificates.
 - c. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - d. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hangers and Supports for Plumbing Piping Equipment:

1. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - a. Design supports for multiple pipes capable of supporting combined weight of supported systems, and system contents.
 - b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - c. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 SLEEVES AND SLEEVE SEALS

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- B. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- C. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 ESCUTCHEONS AND FLOOR PLATES

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. One-Piece Floor Plates: Cast-iron flange[**with holes for fasteners**].

2.4 HANGERS AND SUPPORTS FOR PLUMBING PIPING EQUIPMENT

- 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.
 - a. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATIONS

- A. Install piping free of sags and bends.
- B. Install fittings for changes in direction and branch connections.
- C. Sleeves:
 1. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
 2. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - a. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
 3. Install sleeves for pipes passing through interior partitions.

4. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078446 "Penetration Firestopping."

D. Sleeve-Seal-System Installation:

1. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
2. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

E. Escutcheons and Floor Plates:

1. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
2. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
3. Install floor plates for piping penetrations of equipment-room floors.
4. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

F. Meters and Gages:

1. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
2. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
3. Adjust faces of meters and gages to proper angle for best visibility.

G. Install unions at final connection to each piece of equipment.

H. Install dielectric unions and flanges to connect piping materials of dissimilar metals in gas piping.

I. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

3.2 HANGERS AND SUPPORTS

- A. Comply with MSS SP-69 and MSS SP-89. Install building attachments within concrete or to structural steel.
- B. Install hangers and supports to allow controlled thermal and seismic movement of piping systems.
- C. Install powder-actuated fasteners and mechanical-expansion anchors in concrete after concrete is cured. Do not use in lightweight concrete or in slabs less than 4 inches thick.
- D. Load Distribution: Install hangers and supports so piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

3.3 GENERAL EQUIPMENT INSTALLATIONS

- 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, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 22 05 00

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

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

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

2.2 GENERAL-DUTY VALVES

- A. Valve Sizes: Same as upstream piping unless otherwise indicated.
- B. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions.
- C. End Connections: Threads shall comply with ANSI B1.20.1. Flanges shall comply with ANSI B16.1 for cast-iron valves and with ANSI B16.24 for bronze valves. Solder-joint connections shall comply with ANSI B16.18.
- D. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 600-psig CWP rating.
- E. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full or [regular port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
- F. Bronze, Swing Check Valves: Class 125, bronze body with bronze disc and seat.
- G. Bronze Gate Valves: Class 125, bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.
- H. Bronze-Mounted, Cast-Iron Gate Valves: Class 125, nonrising OS&Y cast-iron body and solid-wedge disc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use gate and ball valves for shutoff duty; globe and ball for throttling duty.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves for each fixture and item of equipment.
- D. Install three-valve bypass around each pressure-reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in a position to allow full stem movement.
- G. Install check valves for proper direction of flow in horizontal position with hinge pin level.

END OF SECTION 22 05 23

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. For adhesives and sealants, documentation including printed statement of VOC content and chemical components.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less according to ASTM E 84.
- B. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less according to ASTM E 84.

2.2 INSULATION MATERIALS

- A. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- C. Mineral-Fiber Blanket Insulation: Comply with ASTM C 553, Type II and ASTM C 1290, Type I.
- D. Mineral-Fiber, Preformed Pipe Insulation: Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ.
- E. Mineral-Fiber, Pipe and Tank Insulation: Complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB; and having factory-applied FSK jacket. Nominal density is 2.5 lb/cu. ft. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
- F. Polyolefin Insulation: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

2.3 ADHESIVES

- A. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less.

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

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less.

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

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less.

2.4 MASTICS

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

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43 dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

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

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less.

B. ASJ 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: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 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.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

PART 3 - EXECUTION

3.1 PIPE INSULATION INSTALLATION

- A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall, Partition, and Floor Penetrations: Install insulation continuously through penetrations. Seal penetrations. Comply with requirements in Section 078413 "Penetration Fire-stopping."
- D. Flexible Elastomeric Insulation Installation:
 1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Mineral-Fiber Insulation Installation:

1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

F. Polyolefin Insulation Installation:

1. Seal split-tube longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of polyolefin pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

G. Interior Piping System Applications: Insulate the following piping systems:

1. Domestic hot water.
2. Recirculated domestic hot water.
3. Roof drain bodies and horizontal rainwater leaders of storm water piping.
4. Exposed water supplies and sanitary drains of fixtures for people with disabilities.

H. Do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Sanitary drainage and vent piping.
3. Drainage piping located in crawlspaces unless otherwise indicated.
4. Chrome-plated pipes and fittings, except for plumbing fixtures for people with disabilities.
5. Piping specialties, including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.2 INDOOR PIPING INSULATION SCHEDULE

A. Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawlspaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.

- b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
- C. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be[one of] the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be[one of] the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.

END OF SECTION 22 07 00

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SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For transition fittings and dielectric fittings.
2. Product for solvent cements and adhesive primers, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 PREFORMANCE REQUIREMENTS

- A. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 PIPE AND FITTINGS

- A. Hard Copper Tubing: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper with wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
1. Copper Unions: Cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
 2. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.
- B. Soft Copper Tubing: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper with copper pressure fittings, cast-copper-alloy or wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
1. Joining Materials: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder.
- C. Galvanized-Steel Piping: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe, with ASME B16.4, Class 125, galvanized, standard pattern gray-iron, threaded fittings.
- D. CPVC Piping: ASTM F 441/F 441M, Schedule 40 pipe with ASTM F 438, CPVC Schedule 40 socket-type fittings.

- E. PEX Tube and Fittings: ASTM F 877, SDR 9 PEX tubing and ASTM F 1807, metal insert-type fittings with copper or stainless-steel crimp rings.
 - 1. Manifold: ASTM F 877 plastic or corrosion-resistant-metal assembly, with a plastic or corrosion-resistant-metal valve for each outlet.
- F. PVC Piping: ASTM D 1785, Schedule 40 pipe with ASTM D 2466, Schedule 40, socket-type fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for basic piping installation requirements.
- B. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for wall penetration systems.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for pressure gages and Section 221119 "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install domestic water piping with 0.25 percent slope downward toward drain for horizontal piping and plumb for vertical piping.
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- F. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for basic piping joint construction.
 - 1. Soldered Joints: Comply with procedures in ASTM B 828 unless otherwise indicated.
- G. Comply with requirements in Section 220500 "Common Work Results for Plumbing" for pipe hanger and support devices.
 - 1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - b. NPS 1-1/2 : 108 inches with 3/8-inch rod.
 - c. Support vertical piping at each floor.
 - 2. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 - b. NPS 1-1/4 to NPS 2 : 48 inches with 3/8-inch rod.
 - c. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

3. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
 - b. Install hangers for vertical PEX piping every 48 inches.
4. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. Install supports for vertical PVC piping every 48 inches.
- H. Install flexible connectors in suction and discharge piping connections to each domestic water pump[and in suction and discharge manifold connections to each domestic water booster pump].

3.2 INSPECTING AND CLEANING

- A. Inspect and test piping systems as follows:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
- B. Clean and disinfect potable and non-potable domestic water piping by filling system with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

3.3 PIPING SCHEDULE

- A. Aboveground Distribution Piping: hard copper tubing Type M , hard copper tubing.

3.4 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller.
 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller.
 3. Hot-Water-Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Install gate valves close to main on each branch and riser serving two or more plumbing fixtures or equipment connections and where indicated.
- C. Install gate or ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.
- D. CPVC and PVC ball, butterfly, and check valves may be used in matching piping materials.

- E. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.
- F. Install swing check valve on discharge side of each pump and elsewhere as indicated.
- G. Install ball valves in each hot-water circulating loop and discharge side of each pump.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product.
2. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 MANUFACTURED UNITS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers <Insert drawing designation if any>:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze..

- B. Hose-Connection Vacuum Breakers :

1. Standard: ASSE 1011.
2. Body: Bronze, non-removable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Rough bronze.

- C. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller.
5. End Connections: Threaded for NPS 2 and smaller.
6. Configuration: Designed for horizontal, straight-through flow.

- 7. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- 8. Piping Finish: Copper.
- D. Y-Pattern Strainers:
 - 1. Pressure Rating: 125 psig minimum unless otherwise indicated.
 - 2. Body: Bronze for NPS 2 and smaller.
 - 3. End Connections: Threaded for NPS 2 and smaller.
 - 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 - 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - 6. Drain: Pipe plug.
- E. Stop-and-Waste Drain Valves <Insert drawing designation if any>:
 - 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
 - 2. Pressure Rating: 200-psig minimum CWP or Class 125.
 - 3. Size: NPS 3/4.
 - 4. Body: Copper alloy or ASTM B 62 bronze.
 - 5. Drain: NPS 1/8 side outlet with cap.
- F. Water-Hammer Arresters <Insert drawing designation if any>:
 - 1. Standard: ASSE 1010 or PDI-WH 201.
 - 2. Type: Metal bellows.
 - 3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
- D. Install Y-pattern strainers for water on supply side of each control valve and water pressure-reducing valve.
- E. Set non-freeze, non-draining-type post hydrants in concrete or pavement.
- F. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

- G. Install water-hammer arresters in water piping according to PDI-WH 201.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 2. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
 - 3. Prepare test and inspection reports.

END OF SECTION 22 11 19

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SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. For solvent cements and adhesive primers, documentation including printed statement of VOC content.
3. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1.2 FIELD CONDITIONS

- A. Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 2. Waste, Force-Main Piping: 50 psig.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components.

2.2 PIPES AND FITTINGS

- A. Copper Drainage Tube and Fittings: ASTM B 306, Type DWV drawn temper with ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
 1. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - a. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
 2. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

- B. Hub-and-Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, Service class; ASTM C 564 rubber gaskets.
- C. Hubless Cast-Iron Soil Pipe and Fittings: ASTM A 888 or CISPI 301, with ASTM C 1277 shielded couplings.
- D. PVC Plastic, DWV Pipe and Fittings: ASTM D 2665, Schedule 40, plain ends with PVC socket-type, DWV pipe fittings.
 - 1. Adhesive Primer: ASTM F 656.
 - a. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent Cement: ASTM D 2564.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Comply with requirements in Section 220513 "Common Work Results for Plumbing" for basic piping installation requirements.
- B. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- C. Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 220513 "Common Work Results for Plumbing" for wall penetration systems.
 - 1. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- H. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- J. Comply with requirements in Section 220513 "Common Work Results for Plumbing" for basic piping joint construction.
- K. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure unless otherwise indicated.
- L. Comply with requirements in Section 220513 "Common Work Results for Plumbing" for pipe hanger and support devices.

3.2 PIPE SCHEDULE

- A. Aboveground Applications: Hubless, cast-iron soil pipe and fittings or PVC plastic.

END OF SECTION 22 13 16

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SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Coordination:

1. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - a. Motor controllers.
 - b. Torque, speed, and horsepower requirements of the load.
 - c. Ratings and characteristics of supply circuit and required control sequence.
 - d. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 MOTOR CHARACTERISTICS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 600 feet above sea level.
- C. PolyPhase Motors:
 1. Description: NEMA MG 1, Design B, medium induction motor.
 - a. Service Factor: 1.15.
 2. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
 3. Rotor: Random-wound, squirrel cage.
 4. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
 5. Temperature Rise: Match insulation rating.
 6. Insulation: Class F.
 7. Code Letter Designation:
 - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

8. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

D. Polyphase Motors with Additional Requirements

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

E. Single Phase Motors:

1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 23 05 13

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING**PART 1 - GENERAL****1.1 Submittals:**

- A. Product Data: For each type of valve indicated.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2.2 GENERAL-DUTY VALVES

- A. Valve Sizes: Same as upstream piping unless otherwise indicated.
- B. Valves in Insulated Piping: With 2-inch stem extensions.
- C. End Connections: Threads shall comply with ANSI B1.20.1. Flanges shall comply with ANSI B16.1 for cast-iron valves and with ANSI B16.24 for bronze valves. Solder-joint connections shall comply with ANSI B16.18.
- D. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 400-psig minimum CWP rating.
- E. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full or regular chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
- F. Bronze Gate Valves: Class 125, bronze body with non-rising stem and bronze solid wedge and union-ring bonnet.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Use gate and ball valves for shutoff duty; globe and ball for throttling duty.
- B. Locate valves for easy access and provide separate support where necessary.

- C. Install valves for each fixture and item of equipment.
- D. Install three-valve bypass around each pressure-reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in a position to allow full stem movement.
- G. Install check valves for proper direction of flow in horizontal position with hinge pin level.

END OF SECTION 23 05 23

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Certified TAB reports.
 - 2. Documentation of work performed per ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
 - 3. Documentation of work performed per ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."
- B. TAB Firm Qualifications: AABC, NEBB or TABB certified.
- C. TAB Report Forms: Standard TAB contractor's forms approved by Architect/Engineer.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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 the approved submittals for HVAC systems and equipment.
- C. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- E. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- F. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- G. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.

3. Integrity of dampers and valves for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in constant and variable air volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

- H. Report deficiencies discovered before and during performance of test and balance procedures.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound units.

3.3 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare schematic diagrams of systems' "as-built" duct layouts.
- B. For variable-air-volume systems, develop a plan to simulate diversity.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check for airflow blockages.
- F. Check condensate drains for proper connections and functioning.
- G. Check for proper sealing of air-handling unit components.
- H. Check for proper sealing of air duct system.

3.4 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data; number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Set system controls so automatic valves are wide open to heat exchangers.
 - 5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.5 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.

END OF SECTION 23 05 93

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SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals:
 - 1. Product Data: For each type of product indicated.
 - 2. For adhesives and sealants, documentation including printed statement of VOC content.
- B. Quality Assurance: Labeled with maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to ASTM E 84.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics:
 - 1. Indoor Insulation and related materials: To be factory labeled designating maximum flame-spread index of 25 or less, and smoke-developed index of 50 or less according to ASTM E 84.
 - 2. Outdoor Insulation and related materials: To be factory labeled designating maximum flame-spread index of 75 or less, and smoke-developed index of 150 or less according to ASTM E 84.

2.2 INSULATION MATERIALS

- A. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- C. Mineral-Fiber Blanket Insulation: Comply with ASTM C 553, Type II and ASTM C 1290, Type I.
- D. Mineral-Fiber, Preformed Pipe Insulation: Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ.
- E. Polyolefin Insulation: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

- F. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Factory-Applied Jackets: When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
- J. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- K. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

- A. Comply with requirements of the Midwest Insulation Contractors Association's "National Commercial & Industrial Insulation Standards" for insulation installation on pipes and equipment.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall, Partition, and Floor Penetrations: Install insulation continuously through penetrations. Seal penetrations. Comply with requirements in Section 078413 "Penetration Firestopping."
- D. Flexible Elastomeric Insulation Installation:
 - 1. Seal longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - 2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Mineral-Fiber Insulation Installation:

1. Insulation Installation on Straight Pipes and Tubes: Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
4. Blanket and Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
5. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier.

F. Polyolefin Insulation Installation:

1. Seal split-tube longitudinal seams and end joints with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
2. Insulation Installation on Pipe Fittings and Elbows: Install mitered sections of polyolefin pipe insulation. Secure insulation materials and seal seams with adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

G. Plenums and Ducts Requiring Insulation:

1. Concealed and exposed supply and outdoor air.
2. Concealed and exposed return air located in nonconditioned space.
3. Concealed and exposed exhaust between isolation damper and penetration of building exterior.

H. Plenums and Ducts Not Insulated:

1. Metal ducts with duct liner.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

I. Piping Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawlspaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.2 DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed duct insulation shall be[one of] the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density for indoor use, and 1-1/2 inches thick and 3.0-lb/cu. Ft with Aluminum jacketing for outdoor use. .

B. Exposed duct insulation shall be[one of] the following:

1. Mineral-Fiber Blanket: 1-1/2 inches and 1.5-lb/cu. ft. nominal density for indoor use.

3.3 HVAC PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

END OF SECTION 23 07 00

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. Shop Drawings: For facility natural-gas piping layout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Building: One distribution pressure. 0.5 psig or less.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

2.3 SPECIALTIES

- A. Strainers: ASTM A 126, Class B, cast-iron body, Y-pattern, full size of connecting piping, CWP rating of 125 psig. Include 40-mesh startup strainer, and perforated stainless-steel basket.
- B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
- C. Service Meters: Comply with gas company requirements.
- D. Detectable Warning Tape: PE film warning tape 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection; colored yellow.

2.4 VALVES

- A. General Requirements for Metallic Manual Gas Shutoff Valves: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
- B. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
 - 1. Body: Bronze, complying with ASTM B 584.
 - 2. Ball: Chrome-plated brass.
 - 3. Stem: Bronze; blowout proof.
 - 4. Seats: Reinforced TFE; blowout proof.
 - 5. Packing: Separate packnut with adjustable stem packing threaded ends.
 - 6. CWP Rating: 600 psig.
 - 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Body: Bronze, complying with ASTM B 584.
 - 2. Ball: Chrome-plated bronze.
 - 3. Stem: Bronze; blowout proof.
 - 4. Seats: Reinforced TFE; blowout proof.
 - 5. Packing: Threaded body packnut design with adjustable stem packing.
 - 6. CWP Rating: 600 psig.
 - 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Bronze Plug Valves: MSS SP-78.
 - 1. Body: Bronze, complying with ASTM B 584.
 - 2. Plug: Bronze.
 - 3. Operator: Square head or lug type with tamperproof feature where indicated.
 - 4. Pressure Class: 125 psig.
 - 5. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 6. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Cast-Iron, Non-lubricated Plug Valves: MSS SP-78.
 - 1. Body: Cast iron, complying with ASTM A 126, Class B.
 - 2. Plug: Bronze or nickel-plated cast iron.
 - 3. Seat: Coated with thermoplastic.
 - 4. Stem Seal: Compatible with natural gas.
 - 5. Operator: Square head or lug type with tamperproof feature where indicated.
 - 6. Pressure Class: 125 psig.
 - 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Valve Boxes: Cast iron, two sections, with base to fit over valve and barrel a minimum of 5 inches in diameter and cover with "GAS" lettering.

- G. Electrically Operated, Automatic Gas Valves: Comply with UL 429.
- H. Earthquake Valves: ASCE 25, listed and labeled by an NRTL acceptable to authorities having jurisdiction.

2.5 PRESSURE REGULATORS

- A. General Requirements: Single stage, steel jacketed, and corrosion resistant. Include elevation compensator.
- B. Line Pressure Regulators: ANSI Z21.80; 2-psig maximum inlet pressure. Factory- or field-installed, stainless-steel screen in vent opening if not connected to vent piping.
- C. Appliance Pressure Regulators: ANSI Z21.18; 1-psig maximum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 INDOOR PIPING INSTALLATION

- A. Comply with requirements in Section 230500 "Common Work Results for HVAC" for basic piping installation requirements.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Piping Installed under Buildings: Install piping under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with a weatherproof vent cap.
- D. Install escutcheons at penetrations of interior walls, ceilings, and floors.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Comply with requirements in Section 078413 "Penetration Fire-stopping."
- F. Install service meters to comply with gas company requirements.
- G. Install gas stops for shutoff to appliances with low-pressure gas supply.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- J. Connect branch piping from top or side of horizontal piping.
- K. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

- L. Install strainer on inlet of each line pressure regulator and automatic or electrically operated valve.
- M. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230500 "Common Work Results for HVAC."
- N. Connect gas piping to equipment and appliances with shutoff valves and unions. Install gas valve upstream from and within 72 inches of each appliance using gas. Install union or flanged connections downstream from valves.
- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to the outdoors and terminate with weatherproof vent cap.
- P. Do not use natural-gas piping as grounding electrode.

3.2 PIPING JOINT CONSTRUCTION

- A. Threaded Joints: Thread pipe with tapered pipe threads complying with ASME B1.20.1.
- B. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators.
- C. Joints in Steel Piping with Protective Coating: Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions conforming to SAE J513. Tighten finger tight then using wrench. Do not over-tighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install anode for metallic valves in underground PE piping.

3.4 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
 - 1. PE pipe and fittings joined by heat-fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.5 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Containment Conduit: Steel with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.6 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Containment Conduit: Steel with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.7 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 23 11 23

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. For solvent cements and adhesive primers, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Condensate-Drain Piping: 140 deg F.
3. Air-Vent Piping: 240 deg F.

2.2 PIPES, TUBES, AND FITTINGS

- A. Hard Copper Tubing: [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 88, Type M (ASTM B 88M, Type C)] with ASME B16.22 wrought-copper solder fittings and ASTM B 32, 95-5 tin antimony solder.
- B. Soft Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A) with ASME B16.22 wrought-copper solder fittings.
- C. CPVC Pipe: ASTM F 441/F 441M, Schedule 40, plain ends with ASTM F 438, socket-type solvent welding fittings.
 1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Pipe: ASTM D 1785, Schedule 40, plain ends with ASTM F 438, socket-type solvent welding fittings.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- E. Steel Pipe: ASTM A 53, Schedule 40, plain ends with malleable-iron threaded fittings, Class 125.
- F. Unions: ASME B16.39, malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

2.3 SPECIAL-DUTY VALVES

- A. Calibrated Plug Valves: 125-psig water working pressure, 250 deg F maximum operating temperature; bronze body with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening.
- B. Pressure-Reducing Valves: Diaphragm-operated, cast-iron or brass-body valve, with low-inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem.
- C. Safety Relief Valves: Brass or bronze body with brass and rubber, wetted, internal working parts; to suit system pressure and heat capacity; according to ASME Boiler and Pressure Vessel Code: Section IV.

2.4 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), threaded connections for NPS 2 and smaller, bolted cover, perforated Type 304 stainless-steel basket, and bottom drain connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements in Section 230500 "Common Work Results for HVAC" for basic piping installation requirements.
- B. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Section 230500 "Common Work Results for HVAC" for wall penetration systems.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping free of sags and bends and install fittings for changes in direction and branch connections.
- E. Use the fewest number of joints belowground and within floor slabs.

- F. Install piping at a uniform slope of 0.2 percent upward in the direction of flow.
- G. Make reductions in pipe sizes using eccentric reducer fitting installed with level side up.
- H. Install branch connections to mains using tee fittings in main with takeoff out the bottom of the main, except for up-feed risers, which shall have swing joint and takeoff out the top of the main line.
- I. Install unions in pipes adjacent to each valve, at final connections with each piece of equipment, and elsewhere as indicated.

3.2 VALVE INSTALLATIONS

- A. Shutoff Duty: Use gate or ball valves.
- B. Throttling Duty: Use globe or ball valves.
- C. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- D. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple and cap.
- F. Install safety relief valves on hot-water generators and elsewhere as required by authorities having jurisdiction. Pipe discharge to floor drain without valves.
- G. Install manual air vents at high points in the system, at heat-transfer coils, and elsewhere as required for system air venting.

3.3 SPECIALTIES INSTALLATIONS

- A. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated.

3.4 TESTING, ADJUSTING, AND BALANCING

- A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens.
- B. Hydrostatically test completed piping at a pressure one and one-half times operating pressure. Isolate equipment before testing piping. Repair leaks and retest piping until there are no leaks.
- C. Balance water flow within distribution system, including submains, branches, and terminals, to indicated quantities as required by Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.5 PIPING SCHEDULE

A. Hot Water, NPS 2 and Smaller:

1. Aboveground: Drawn-temper copper tubing with soldered joints, or steel pipe with threaded joints.

B. Condensate Drain Lines: Drawn-temper copper tubing with soldered joints or PVC pipe with solvent-welded joints.

END OF SECTION 23 21 13

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. Documentation indicating that duct systems and accessories comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
3. Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning." and Section 6.4.4 - "HVAC System Construction and Insulation."
4. Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
5. For adhesives and sealants, documentation including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- G. Comply with NFPA 96 for ducts connected to commercial kitchen hoods.
- H. Comply with UL 181 for ducts and closures.

2.2 DUCTS

- A. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G90 hot-dip galvanized coating.

1. Galvanized Coating Designation: G90.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- B. Joint and Seam Tape, and Sealant: Comply with UL 181A.
- C. Rectangular Metal Duct Fabrication: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
 1. Thickness: 1 inch.
 2. Airstream surface coated with an antimicrobial erosion-resistant coating.
 3. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 4. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment.

2.3 ACCESSORIES

- A. Volume Dampers and Control Dampers: Single-blade and multiple opposed-blade dampers, standard leakage rating, and suitable for horizontal or vertical applications; factory fabricated and complete with required hardware and accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Outdoor, Supply-Air Ducts: Seal Class A.
 2. Outdoor, Exhaust Ducts: Seal Class C.
 3. Outdoor, Return-Air Ducts: Seal Class C.
 4. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 5. Unconditioned Space, Exhaust Ducts: Seal Class C.
 6. Unconditioned Space, Return-Air Ducts: Seal Class B.
 7. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 8. Conditioned Space, Exhaust Ducts: Seal Class B.
 9. Conditioned Space, Return-Air Ducts: Seal Class C.
- C. Conceal ducts from view in finished and occupied spaces.
- D. Avoid passing through electrical equipment spaces and enclosures.
- E. Support ducts to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Hangers and Supports."

- F. 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.
- G. Install volume and control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- H. Install fusible links in fire dampers.
- I. Clean new and existing duct systems before testing, adjusting, and balancing.

3.2 TESTING, ADJUSTING, AND BALANCING

- A. Balance airflow within distribution systems, including submains, branches, and terminals to indicated quantities.

END OF SECTION 23 31 00

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SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Products shall be licensed to use the AMCA-Certified Ratings Seal.
- B. Power ventilators shall comply with UL 705.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CENTRIFUGAL VENTILATORS

- A. Manufacturers: One of the following:
- B. Basis-of-Design Product: Product indicated on Drawings or a comparable product of one of the following:
 1. Acme Engineering & Manufacturing Corporation.
 2. Greenheck Fan Corporation.
 3. Loren Cook Company.
- C. Housing: Removable, spun-aluminum, dome top, one-piece with downblast configuration.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing.
 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
- F. Accessories:
 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2-inch mesh, galvanized.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Overall Height: 12 inches.
 - 2. Pitch Mounting: Manufacture curb for roof slope.
 - 3. Mounting Pedestal: Galvanized steel with removable access panel.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units with clearances for service and maintenance.
- B. Roof-Mounted Units: Install roof curb on roof structure, according to [ARI Guideline B.] Install and secure roof-mounted fans on curbs, and coordinate roof penetrations and flashing with roof construction.
- C. Ground power ventilators.

END OF SECTION 23 34 23

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated.
2. Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

2.2 SHUTOFF SINGLE-DUCT CONSTANT AIR VOLUME TERMINAL UNITS

- A. Manufacturers:[One of the following:]
- B. Basis-of-Design Product: Product as indicated on Drawings or a comparable product of one of the following:
 1. Krueger.
 2. Price Industries.
 3. Titus.
 4. Trane; a business of American Standard Companies.
 5. Tuttle & Bailey.
- C. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
- D. Casing: 0.034-inch single wall.
 1. Casing Lining: Adhesive attached, 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections[, size matching inlet size].

4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
- F. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins, and rated for a minimum working pressure of 200 psig. Include manual air vent and drain valve.
- G. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include primary and secondary overtemperature protection, nickel-chrome 80/20 heating elements, fan interlock contacts, disconnect switch, fuses (for coils more than 48 A), and magnetic contactor for each step of control (for three-phase coils).
- H. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls.
- I. Control Sequence:
 1. Suitable for operation with duct pressures between 0.25- and 2.0-inch wg inlet static pressure.
 2. System-powered, wall-mounted thermostat.
- J. Capacities and Characteristics: See Drawings

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install piping adjacent to air terminal units to allow service and maintenance.
- D. Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- E. Connect ducts to air terminal units.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For each type of product indicated, including color charts for factory finishes.

PART 2 - PRODUCTS

2.1 OUTLETS AND INLETS

A. Ceiling Diffusers:

1. Manufacturers: One of the following:
2. Basis-of-Design Product: Product as indicated on Drawings or a comparable product of one of the following:
 - a. Price Industries.
 - b. Krueger
 - c. Titus.
 - d. Tuttle & Bailey.
3. Material : Steel
4. Finish: Baked enamel, white or color selected by Architect/Engineer.
5. Mounting: T-bar.

B. Wall Registers:

1. Manufacturers: One of the following:
 - a. Krueger.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
2. Material: Steel.
3. Finish: Baked enamel, white or color selected by Architect/Engineer.
4. Mounting: Countersunk screw.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Make final locations where indicated, as much as practical. For units installed

in lay-in ceiling panels, locate units in the center of panel unless otherwise indicated. Where architectural features or other items conflict with installation, notify Architect/Engineer for a determination of final location.

- C. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 74 13 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged, outdoor, central-station rooftop units with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Economizer outdoor- and return-air damper section.
 - 3. Integral, space temperature controls.
 - 4. Roof curbs.

1.2 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operation. "Supply air" is defined as the air entering a space from air-conditioning, or ventilating apparatus.
- H. CVT: Constant-air volume and temperature.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design RTU supports to comply with wind performance requirements.
- B. Wind-Restraint Performance:
 - 1. Basic Wind Speed: 30 mph

2. Minimum 10 lb/sq. ft multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.4 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria.
 1. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Structural members to which RTUs will be attached.
 2. Roof openings
 3. Roof curbs and flashing.
- B. Field quality-control test reports.
- C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fan Belts: One set for each belt-driven fan.
 2. Filters: One set of filters for each unit.

1.8 QUALITY ASSURANCE

- A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of the following:

1. Johnson Controls Inc.
2. Trane
3. Carrier

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: 0.052 inch thick.

- C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I.
 - 2. Thickness: 1 inch.
 - 3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
 - 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- D. Condensate Drain Pans: Formed sections of galvanized steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.B9.
 - 1. Drain Connections: Threaded nipple.
 - 2. Pan-Top Surface Coating: Corrosion-resistant compound.
- E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

- A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Propeller, shaft mounted on permanently lubricated motor.
- D. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

- A. Supply-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Condensate Drain Pan: Galvanized steel formed with pitch and drain connections complying with ASHRAE 62.B9.
- B. Outdoor-Air Refrigerant Coil: Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: Two.
- B. Compressor: Hermetic, reciprocating or scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Hot-gas bypass solenoid valve with a replaceable magnetic coil.

2.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Pleated: MERV 7.

2.7 DAMPERS

- A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
 1. Damper Motor: Modulating with adjustable minimum position.
 2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.8 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS

- A. Manufacturer: Provide controls by the following:
 1. Siemens.
- B. Basic Unit Controls:
 1. Control-voltage transformer.
 2. Wall-mounted thermostat or sensor with the following features:
 - a. Cool-off switch.
 - b. Fan on-auto switch.
 - c. Adjustable deadband.
 - d. Exposed set point.
 - e. Exposed indication.
 - f. Degree F indication.

C. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected.
 - b. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.
3. Supply Fan Operation:
 - a. Occupied and Unoccupied Periods: Run fan continuously.
4. Refrigerant Circuit Operation:
 - a. Occupied and Unoccupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
5. Fixed Minimum Outdoor-Air Damper Operation:
 - a. Occupied and Unoccupied Periods: Open to 15 percent.
6. Economizer Outdoor-Air Damper Operation:
 - a. Occupied and Unoccupied Periods: Open to 15 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use outdoor-air enthalpy to adjust mixing dampers. During economizer cycle operation, lock out cooling.

D. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, and supply, return, outside and room-air temperature.
 - d. Monitoring economizer cycles.

2.10 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Low-ambient kit using staged condenser fans for operation down to 35 deg F.

- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

2.11 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C 1071, Type I or II.
 - b. Thickness: 1 inch thickness.
 - 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C 916, Type I.
- B. Curb Height: 14 inches.

2.12 CAPACITIES AND CHARACTERISTICS

- A. See Schedules:

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 RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Roof Curb: Install RTUs on curbs and coordinate roof penetrations and flashing with architectural trades.

3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to RTUs with flexible duct connectors.
 - 4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:
 - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.

2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean condenser coil and inspect for construction debris.
9. Inspect operation of barometric relief dampers.
10. Verify lubrication on fan and motor bearings.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.
16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
20. Inspect controls for correct sequencing of mixing dampers, refrigeration, and normal and emergency shutdown.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
22. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
23. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. Economizer to minimum outdoor-air changeover.
 - b. Relief-air fan operation.
 - c. Smoke and alarms.

24. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 74 13

SECTION 23 84 13 - HUMIDIFIERS**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: Steam injection humidifiers.

1.3 DEFINITION

- A. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, manifolds, and attachments to other work.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members to which humidifiers will be attached.
 - 2. Size and location of initial access modules for acoustical tile.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Supply one replacement electrode cylinder with each self-contained humidifier.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ARI 640, "Commercial and Industrial Humidifiers."

1.9 COORDINATION

- A. Coordinate location and installation of humidifiers with manifolds in ducts and air-handling units or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

PART 2 - PRODUCTS

2.1 STEAM-INJECTION HUMIDIFIERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong International, Inc.
 - 2. DRI-STEEM Humidifier Company.
 - 3. Hermidifier.
 - 4. Nortec Industries Inc.
- B. Manifold: ASTM A 666, Type 304 stainless steel, insulated with 1/2-inch fiberglass and stainless-steel jacket; and extending the full width of duct or plenum with mounting brackets at ends where shown on drawings.
- C. Discharge Nozzle and Dispersion Fan:
 - 1. Steam-jacketed discharge nozzle, aluminum blade propeller fan with finger guard, and single-speed motor interlocked to operate with humidifier.
 - 2. Fan Mounting: Above and behind discharge outlet on bracket integral to discharge outlet.
- D. Steam Separator: Cast iron, ASTM A 666, Type 304 stainless steel with humidifier control valve.
- E. Humidifier Control Valve:
 - 1. Actuator: Electric modulating with spring return.
 - 2. Actuator: As specified in Section 230923.11 "Control Valves."

- F. Steam Trap: Inverted-bucket type, sized for a minimum of 3 times the maximum rated condensate flow of humidifier at 1/2-psig inlet pressure.
- G. Accessories:
 - 1. Wall mounted humidistat.
 - 2. Aquastat mounted on steam condensate return piping to prevent cold operation of humidifier.
 - 3. In-line strainer.
 - 4. Airflow switch for preventing humidifier operation without airflow.
- H. Capacities and Characteristics: See drawings
 - 1. Electrical Characteristics: Single point of connection.
 - a. Volts: 120
 - b. Phase: 1
 - c. Hertz: 60

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install humidifiers with required clearance for service and maintenance.[Maintain path, downstream from humidifiers, clear of obstructions as required by ASHRAE 62.1.]
- B. Seal humidifier manifold duct or plenum penetrations with flange.
- C. Install humidifier manifolds in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- D. Install galvanized steel drain pan under each manifold mounted in duct.
 - 1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1].
 - 2. Connect to condensate trap and drainage piping.
 - 3. Extend drain pan upstream and downstream from manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.
- E. Install manifold supply piping pitched to drain condensate back to humidifier.

- F. Install drip leg upstream from steam trap a minimum of 12 inches tall for proper operation of trap.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Install piping adjacent to humidifiers to allow service and maintenance.
 - 2. Install shutoff valve, strainer, and union in humidifier makeup line.
- B. Install electrical devices and piping specialties furnished by manufacturer but not factory mounted.
- C. Install piping from safety relief valves to nearest floor drain.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 84 13

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals:

1. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

2.2 RACEWAYS

A. Raceways:

1. EMT: ANSI C80.3 and UL 797.
2. FMC: UL 1; zinc-coated steel.
3. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.
4. GRC: ANSI C80.1 and UL 6, hot-dip galvanized.
5. LFMC: UL 360, zinc-coated, flexible steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
6. Raceway Fittings: Specifically designed for raceway type used in Project.

B. Surface Raceways:

1. Plastic: PVC, extruded and fabricated to size and shape indicated in color selected, with snap-on cover and mechanically coupled connections with plastic fasteners.

2.3 CONDUCTORS AND CABLES

A. Conductors:

1. Comply with NEMA WC70.
2. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
3. Conductors, Larger than No. 10 AWG: Stranded copper.
4. Insulation: Thermoplastic, Type THHN-THWN.
5. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

2.4 GROUNDING MATERIALS

- A. Conductors: Solid for No. 8 AWG and smaller, and stranded for No. 6 AWG and larger unless otherwise indicated.
 - 1. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
 - 2. Bare, Solid-Copper Conductors: Comply with ASTM B 3.
 - 3. Bare, Stranded-Copper Conductors: Comply with ASTM B 8.

2.5 ELECTRICAL IDENTIFICATION MATERIALS

- A. Raceway Identification Materials: Self-adhesive, color-coding vinyl tape; flexible, preprinted, self-adhesive vinyl.
- B. Conductor Identification Materials: Color-Coding Conductor Tape: Self-adhesive vinyl tape 1 to 2 inches wide.
- C. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
- E. Equipment Identification Labels: Engraved, laminated acrylic or melamine label; punched or drilled for screw mounting. White letters on a dark-gray background; red letters for emergency systems.
- F. Fasteners: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.6 SUPPORT AND ANCHORAGE COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.
 - 1. Channel Dimensions: Selected for structural loading.
- B. Raceway and Cable Supports: As described in NECA 1.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and fittings.
- D. Mounting, Anchoring, and Attachment Components:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, high strength; complying with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.7 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized-steel sheet.
- D. Sleeve Seals: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2.8 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining.

PART 3 - EXECUTION

3.1 GENERAL ELECTRICAL EQUIPMENT INSTALLATION REQUIREMENTS

- A. Install electrical equipment to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
- B. Install electrical equipment to provide for ease of disconnecting the equipment with minimum interference to other installations.
- C. Install electrical equipment to allow right of way for piping and conduit installed at required slope.
- D. Install electrical equipment to ensure that connecting raceways, cables, and wireways, are clear of obstructions and of the working and access space of other equipment.
- E. Install required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- F. Install sleeve and sleeve seals of type and number required for sealing electrical service penetrations of exterior walls.
- G. Comply with NECA 1.

3.2 RACEWAY AND CABLE INSTALLATION

A. Outdoor Raceways Applications:

1. Exposed or Concealed: IMC.
2. Connection to Vibrating Equipment: LFMC.
3. Boxes and Enclosures: Metallic, NEMA 250, Type 3R or Type 4.

B. Indoor Raceways Applications:

1. Exposed or Concealed: EMT.
2. Connection to Vibrating Equipment: FMC; in wet or damp locations, use LFMC.
3. Damp or Wet Locations: IMC.
4. Boxes and Enclosures: Metallic, NEMA 250, Type 1, unless otherwise indicated.

C. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.

D. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

E. Install pull wires in empty raceways.

F. Connect motors and equipment subject to vibration, noise transmission, or movement with a 72-inch maximum length of flexible conduit.

G. Install raceways and cables conceal within finished walls, ceilings, and floors unless otherwise indicated.

H. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

I. Installation of Hangers and Supports:

1. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in this article.
2. Separate dissimilar metals and metal products from contact with wood or cementitious materials, by painting each metal surface in area of contact with a bituminous coating or by other permanent separation.
3. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, as permitted in NFPA 70.
4. Multiple Raceways or Cables: Install on trapeze-type supports fabricated with steel slotted channel.
5. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
6. 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 or required by Code:
 - a. To Wood: Fasten with lag screws or through bolts.
 - b. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

- c. To Light Steel: Sheet metal screws.
- d. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.

3.3 WIRING METHODS

- A. Exposed Feeders, Branch Circuits, and Class 1 Control Circuits: Type THHN-THWN, single conductors in raceway.
- B. Feeders and Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- C. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 GROUNDING

- A. Install grounding conductors routed 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.

3.5 IDENTIFICATION

- A. Power-Circuit Conductor Identification: For No. 3 AWG conductors and larger, at each location where observable, identify phase using color-coding conductor tape.
- B. Warning Labels for Enclosures for Power and Lighting: Comply with 29 CFR 1910.145; identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- C. Equipment Identification Labels:
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
 - b. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
- D. Verify identity of each item before installing identification products.
- E. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- F. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

- G. Install system identification color banding for raceways and cables at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Ungrounded branch-circuit conductors.
 - 1. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 2. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points.

3.6 SLEEVE AND SLEEVE-SEALS INSTALLATION

- A. Cut sleeves to length for mounting flush with both wall surfaces.
- B. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- C. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Section 079200 "Joint Sealants."

3.7 FIRESTOPPING

- A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Comply with requirements in Section 078413 "Penetration Fire stopping."

END OF SECTION 26 05 00

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DEVICES

- A. Indoor, Ceiling-Mounted Dual technology Sensors: Solid-state, light-level sensor unit complying with UL 773A, with separate relay unit rated for 20 - A ballast load at 120V AC. Cadmium sulfide photo resistors are not acceptable.

1. Products:

- a. Cooper Controls, Greengate
- b. Wattstopper
- c. Leviton
- d. Hubbell

2. Type: Adaptive Dual technology (passive infrared and ultrasonic).

3. Voltage: 120V.

4. Switch Rating: Dry contacts rated for 20-A ballast load at 120V AC, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac.

5. 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.

6. Time Delay: Adjustable from 5 to 300 seconds.

7. Set-Point Adjustment: With deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.

8. Indicator: Two LEDs.

9. Minimum Coverage Area: 2,000 sq. ft.

- B. Indoor, Wall-Switch Occupancy Sensors:

1. Products:

- a. Cooper Controls, Greengate
- b. Wattstopper
- c. Leviton
- d. Hubbell

2. Type: Adaptive Dual technology (passive infrared and ultrasonic).
3. Voltage: 120V.
4. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
5. Time Delay: Adjustable up to 30 minutes.
6. Field of View: 180 degrees.
7. Minimum Coverage Area: 1,200 sq. ft. (111 sq. m).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- C. Label time switches and contactors with a unique designation.
- D. Verify actuation of each sensor and adjust time delays.

END OF SECTION 26 09 23

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

2.2 COMMERCIAL-GRADE DEVICES

- A. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.
- B. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: White or as selected by the Owner unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
- C. Convenience Receptacles: NEMA WD 1, NEMA WD 6, Configuration 5-20R, and UL 498.
 - 1. Products:
 - a. Cooper; 5351 (single), CR5362 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).
- D. Duplex GFCI Convenience Receptacles: 125 V, 20 A, straight blade, non-feed-through type. NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
 - 1. Products:
 - a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.

- d. Leviton; 7590.
- E. Toggle Switches: NEMA WD 1 and UL 20. 120/277 V, 20 A.
 - 1. Products:
 - 1) Single Pole:
 - a) Cooper; AH1221.
 - b) Hubbell; HBL1221.
 - c) Leviton; 1221-2.
 - d) Pass & Seymour; CSB20AC1.
 - 2) Three Way:
 - a) Cooper; AH1223.
 - b) Hubbell; HBL1223.
 - c) Leviton; 1223-2.
 - d) Pass & Seymour; CSB20AC3.
- F. Telephone / Data Outlet: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e or 6. Coordinate with the Owner. Comply with UL 1863.

2.3 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider with toggle switch; with single-pole or three-way switching. Comply with UL 1472.
- C. LED Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF".

2.4 WALL PLATES

- A. Wall Plates, Finished Areas: Satin-finish stainless steel fastened with metal screws having heads matching plate color.

2.5 MULTIOUTLET ASSEMBLIES

- A. Components produced by a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles. PVC raceway with No. 12 AWG wire. Receptacles and data outlets as shown on the drawings.

PART 3 - ""EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- C. Select device colors and wall plates as follows:
 - 1. For plastic covers, match device color.
 - 2. Above kitchen counters, use white devices with stainless-steel wall plates.
- D. Install unshared neutral conductors on line and load side of dimmers.
- E. Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multi-gang wall plates.

END OF SECTION 26 27 26

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SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: None

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA FU 1 for cartridge fuses.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Feeders: Provide high interrupting capacity (current-limiting) and UL tested, listed and labeled Class L, Class RK1, Class RK5, and Class J as required by the application.
- B. Motor Branch Circuits: Class RK1 or Class RK5, time delay.
- C. Other Branch Circuits: Class RK1, time delay; Class RK5, time delay; Class J, fast acting or Class J, time delay as required by the application.
- D. Control Circuits: Class CC, fast acting.

3.2 INSTALLATION

- A. Install fuses so rating information is readable without removing fuse.
- B. Install labels indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION 26 28 13

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SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Fusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, that accommodate specified fuses, and with lockable handle interlocked with cover in closed position.
- B. Nonfusible Switches, 600 A and Smaller: UL 98 and NEMA KS 1, Type HD, with lockable handle interlocked with cover in closed position.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Description: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with field-adjustable instantaneous trip settings.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
 - 5. GFEP Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
- B. Features and Accessories:
 - 1. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - 2. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.4 ENCLOSURES

- A. NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260500 "Common Work Results for Electrical."
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

END OF SECTION 26 28 16

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CONTROLLERS AND ACCESSORIES

- A. Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on or tripped.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, and external reset push button.
 - 2. Pilot light.
- D. Magnetic Controllers: Full voltage, across the line, electrically held.
 - 1. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 2. Control Circuits: 120-V ac.
 - 3. Overload Relays: Inverse-time-current characteristic; NEMA ICS 2, and overload reset push button.
- E. Enclosures: NEMA ICS 6, Type 1 unless otherwise indicated.
 - 1. Outdoor Locations: Type 3R.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260500 "Common Work Results for Electrical."
- C. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
- D. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.
- E. Set field-adjustable switches and circuit-breaker trip ranges.

END OF SECTION 26 29 13

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including occupancy sensors.

1.2 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.

1.3 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 IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project, 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. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: One for every 10 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 10 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61.
- G. CRI of minimum 80. CCT of 4100 K.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- L. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Powder-coat painted finish.

2.2 DOWNLIGHT

- A. Manufacturers: Refer to the Luminaire Schedule.
- B. Minimum 700 lumens. Minimum allowable efficacy of 80 lumens per watt.
- C. Universal mounting bracket.
- D. Integral junction box with conduit fittings.

2.3 RECESSED LINEAR

- A. Manufacturers: Refer to the Luminaire Schedule.
- B. Minimum 3,000 lumens. Minimum allowable efficacy of 85 lumens per watt.
- C. Integral junction box with conduit fittings.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers:
 - 1. Prismatic acrylic
 - 2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Powder-coat painted finish.
- E. 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 for all luminaires.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE 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. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for 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 fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect/Engineer, 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. Install lamps in each luminaire.
- D. 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 vertical force of 400 percent of luminaire weight.
- E. 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.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- F. Comply with requirements in Section 260500 "Common Work Results for Electrical" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260500 "Common Work Results for Electrical".

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 26 51 19

SECTION 28 31 12 - ZONED FIRE-ALARM SYSTEM**PART 1 - GENERAL****1.1 SECTION REQUIREMENTS**

- A. Submittals: Product Data and system operating description.
- B. Submittals to Authorities Having Jurisdiction (AHJ): In addition to distribution requirements for submittals, make an identical submittal to the AHJ. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with NFPA 72.
- B. UL listed and labeled.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS DESCRIPTION

- A. Noncoded, conventional, hardwired, zoned, 24-V dc loop system.

2.3 FIRE-ALARM CONTROL UNIT

- A. Fire-Alarm Control Unit: Existing. National Time and Signal Corporation.

2.4 SYSTEM SMOKE DETECTORS

- A. Duct Smoke Detectors: Photoelectric type, complying with UL 268A.

2.5 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output:
 - a. Indicated on Drawings.
 - b. 15/30/75/110 cd, selectable in the field.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to the existing control panel in the existing part of the building.
 - 2. Connect new equipment to the existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement the existing control and monitoring equipment as necessary to extend the existing control and monitoring functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

3.2 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by the AHJ, the Owner and the Architect/Engineer.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct the visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing, and Maintenance" Chapter in NFPA 72.
- D. Prepare test and inspection reports.
- E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

- F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with the visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 28 31 12

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