

**PROJECT MANUAL**

**FOR**

**JUNIOR ACHEIVEMENT  
AUGUSTA, GEORGIA**

**FOR**

**OWNER**

**JUNIOR ACHIEVEMENT OF GEORGIA  
275 NORTHSIDE DRIVE NW  
ATLANTA, GEORGIA 30014**

**ARCHITECT**

**RULE JOY TRAMMELL + RUBIO, LLC  
ARCHITECTURE + INTERIOR DESIGN  
300 GALLERIA PARKWAY  
SUITE 740  
ATLANTA, GEORGIA 30339**

**ISSUED FOR CONSTRUCTION**

**COMMISSION NO. 22-024.00**

**DATE: FEBRUARY 3, 2023**

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1. Owner Furnished Products: Items as Indicated on Drawings.
2. Contractor's Use of Premises: During construction, Contractor will have full use of building area indicated as approved by Owner. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project and as follows: Owner may occupy premises during construction. Perform construction during hours as coordinated with and approved by Owner. Clean up work areas at the end of each work period. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to the least amount feasible, and as agreed to with Owner. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, visitors and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
3. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

END OF SECTION 011000

**SECTION 012000 – UNIT PRICES, ALTERNATES AND PAYMENT PROCEDURES**

1. Unit Prices (If included in project): Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
2. Alternates (If included in project): Alternates are part of the Work only if enumerated in the Agreement. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate. Notification: Immediately following award of the Contract, notify each party involved, in writing, whether alternates have been accepted, rejected, or deferred for later consideration.
3. Submit a Schedule of Values at least seven days before the initial Application for Payment. Break down the Contract Sum into at least one line item for each Specification Section in the Project Manual table of contents. Coordinate the schedule of values with Contractor's construction schedule.
4. Application for Payment Forms: Use AIA Document G702 and AIA Document G703, forms provided by Owner, or forms acceptable to Interior Designer and Owner as form for Applications for Payment.
5. Submit digital copies of each application for payment according to the schedule established in Owner/Contractor Construction Agreement. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

END OF SECTION 012000

**SECTION 013000 - ADMINISTRATIVE AND SUBMITTAL REQUIREMENTS**

1. Action Submittals: Written and graphic information and physical samples that require Interior Designer's responsive action.
2. Informational Submittals: Written and graphic information and physical samples that do not require Interior Designer's responsive action. Submittals may be rejected for not complying with requirements.
3. Maintenance Material Submittals: Attic stock requirements for products to be supplied by the Contractor for Owner's future use.
4. Working Days: Working days, excluding holidays and weekends.
5. Interior Designer's Digital Data Drawing Files: Electronic digital data files of the Contract Drawings will be provided by Interior Designer in accordance with the "Agreement for Transfer of Digital Data Drawing Files". Interior Designer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
6. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
7. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows: Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item. Name file with unique identifier, including project identifier, Specification Section number, and revision identifier.
8. Paper Submittals: When requested by Interior Designer for certain submittals, submit paper copies of the electronic submittal in addition to the electronic submittal.
9. Identify options requiring selection by Interior Designer.
10. Clearly identify deviations from the Contract Documents on submittals.
11. Product Data: Mark each copy to show applicable products and options. Include the following: Manufacturer's written recommendations, product specifications, and installation instructions. Wiring diagrams showing factory-installed wiring. Printed performance curves and operational range diagrams. Testing by recognized testing agency. Compliance with specified standards and requirements.
12. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Include the following: Dimensions and identification of products; fabrication and installation drawings and roughing-in and setting diagrams; wiring diagrams showing field-installed wiring; notation of coordination requirements; notation of dimensions established by field measurement.
13. Samples: Submit actual Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed. Include name of manufacturer and product name on label. If variation is inherent in material or product, submit at least three sets of paired units that show variations, unless otherwise indicated in individual Specification Sections.
14. Delegated Design Services: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated. If

- criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Interior Designer.
15. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and one paper copy of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
  16. Submit a comprehensive Gantt-Chart Schedule, fully developed, horizontal Gantt-chart-type schedule within 15 days of date established for the Notice to Proceed. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  17. Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Interior Designer and additional time for handling and reviewing submittals required by those corrections. Allow time for submittal review, including time for resubmittals. Time for review shall commence on Interior Designer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  18. Submittal Review: Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Interior Designer. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  19. Interior Designer's review, approval or other appropriate action is only for checking for conformance with information given and the design concept expressed in the Contract Documents. Interior Designer's approval of a specific item shall not indicate approval of an assembly in which the item is a component.
  20. Interior Designer's review of Contractor's submittals shall not relieve Contractor of responsibility for deviation from Contract Documents unless Contractor has informed Interior Designer in writing of such deviation at time of submission and Interior Designer has given written approval to the specific deviation. Interior Designer's review shall not relieve Contractor from responsibility for errors and omissions in submittals.

END OF SECTION 013000

**SECTION 014000 - QUALITY REQUIREMENTS**

1. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
2. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Interior Designer for a decision.
3. Conflicting Requirements – Drawings and Specifications are complementary. If conflicts are noted between Drawings and Specifications, then notify Interior Designer prior to determination of “Guaranteed Maximum Price”. If conflicts are discovered that are not brought to the attention of the Interior Designer prior to the establishment of Guaranteed Maximum Price, then the higher cost value of the items in question shall be considered the basis of the “Guaranteed Maximum Price”.
4. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum. The actual installation may exceed the minimum within reasonable limits. Indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Interior Designer for a decision.
5. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, notices, receipts for fee payments, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
6. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.
7. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

END OF SECTION 014000





**SECTION 017300 - EXECUTION**

1. Cutting and Patching: Structural Elements: Do not cut structural elements without prior approval from Interior Designer / Structural Engineer. When cutting, patching or grinding structural elements, notify Interior Designer / Structural Engineer of locations and details of cutting and await directions from Interior Designer / Structural Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Interior Designer's opinion, reduce the building's aesthetic qualities.
2. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.
3. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated. Make vertical work plumb and make horizontal work level. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated. Maintain minimum headroom clearances as noted on Drawings and as required by code. Comply with manufacturer's written instructions and recommendations. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
4. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. Where size and type of attachments are not indicated, verify size and type required for load conditions.
5. Use products, cleaners, and installation materials that are not considered hazardous.
6. Provide temporary support of work to be cut.
7. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
8. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas unless specifically reviewed with Owner and approved by Owner.
9. Cutting: Cut in-place construction using methods least likely to damage elements retained or adjoining construction.
10. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will minimize evidence of patching and refinishing. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

11. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.

END OF SECTION 017300

**SECTION 017700 - CLOSEOUT REQUIREMENTS**

1. Closeout Submittals: Submit in Accordance with Owner / Contractor Agreement and the following:
  - a. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
  - b. Certified List of Incomplete Items: Final submittal at Final Completion.
  - c. Operation and Maintenance Data: Submit one electronic .pdf file and one paper copy of manual.
  - d. Closeout Submittal Manual: Assemble into a composite electronically indexed file. Submit on digital media (.pdf files).
  - e. Record Drawings: Submit one paper set(s) of marked-up record prints in addition to an electronic pdf copy.
  - f. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
2. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
3. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following: Obtain and submit releases from Authorities Having Jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases. Submit closeout submittals specified in other sections, including project record documents, operation and maintenance manuals, property surveys, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Interior Designer. Submit test/adjust/balance records.
4. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following: Advise Owner of pending insurance changeover requirements. Make final changeover of permanent locks and deliver keys to Owner. Complete startup and testing of systems and equipment. Perform preventive maintenance on equipment used prior to Substantial Completion. Participate with Owner in conducting inspection and walkthrough with local emergency responders. Remove temporary facilities and controls. Complete final cleaning requirements, including touchup painting. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
5. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Interior Designer will proceed with inspection or advise Contractor of unfulfilled requirements. Interior Designer will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.
6. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following: Submit a final Application for Payment. Submit certified copy of Interior Designer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Interior Designer. Certified copy of the list shall state that each item has been completed or otherwise resolved. Certificate of Insurance:

Submit evidence of final, continuing insurance coverage complying with insurance requirements.

7. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique. Provide also in pdf format.
8. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
9. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

END OF SECTION 017700

**SECTION 033543 - POLISHED CONCRETE FINISHING**

1. Summary: Section includes polished concrete finishing, including grinding, honing, staining, application of densifier, and application of sealer/stain protector.
2. Submittals: Product Data for each type of product, Maintenance Data.
3. Sample Verification: Submit for each finish and exposed colors.
4. Performance Requirements: Dynamic Coefficient of Friction (for completed polished floor application): Not less than 0.42, per ANSI 137.1.
5. Manufacturer Qualifications: Minimum 10 years of documented experience producing the specified products.
6. Installer Qualifications: Minimum 5 years of documented experience with work of similar scope and complexity required by this Project and certified by manufacturer of concrete polishing products.
7. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups using materials indicated for the completed Work.
8. Single Source Manufacturer of Concrete Polishing Products: Products / material components of concrete polishing system shall be provided by, or as recommended in writing by, a single "Concrete Polishing Products Manufacturer."
9. Basis-of Design Manufacturer: SikaColor or subject to conformance with requirements, comparable products by one of the below:
  - a. Ameripolish, Inc.
  - b. RetroPlate Concrete Polishing System.
10. Concrete Polishing Basis-Of-Design Products:
  - a. Pre-Densifier Floor Cleaner: As recommended by densifier manufacturer.
  - b. Concrete Dye: Formula One Liquid Dye Concentrate. Color: As indicated on Finish Schedule.
  - c. Densifier: Formula One MP Lithium Densifier.
  - d. Sealer/Stain Protector: Scofield Formula One Guard-W.
11. Accessory cleaning materials: As recommended in writing by concrete polishing products manufacturer.
12. Concrete Repair material (If approved by Owner / Architect – repair material shall be reviewed and approved or disapproved during mockup review): Basis-of-Design –Product as recommended by basis-of-design manufacturer. Material shall have ability to receive dye and shall be tinted to match adjacent surface prior to dye application.
13. Grout Material (If approved by Owner / Architect – grout material shall be approved or not during mockup review): Basis-of-Design – Product as recommended by basis-of-design manufacturer and shall have ability to receive dye.
14. Joint Filler: Basis-of Design product as recommended in writing by manufacturer of concrete polishing products. Provide colored to match existing concrete color.
15. Examine concrete topping slab substrates at locations where concrete polishing shall occur, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify that substrates are dry; clean; free of coatings that are incompatible with polishing materials, including substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required for installations indicated. Verify satisfactory installation of control joints.
16. Testing of Concrete Topping Slab: Test slab to comply with manufacturer requirements. Proceed with installation only after unsatisfactory conditions have been corrected.

17. Polishing: Following procedures are general steps to accomplish the specified finish. Application procedure may vary due to unique project conditions including – but not limited to - hardness of concrete. Subject to compliance with requirements, procedures used to accomplish approved mock-up shall prevail. Conformance or deviation from the following steps does not remove contractor from providing the specified finish.
18. Cut Level to be Grade 1 – Light sand exposure finish. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
19. Finished Gloss Level: Class 1: 400 grit, and per approved mockup.
20. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
21. Repair of Surface Imperfections (If approved by Owner / Architect): Provide repair material capable of matching final finish of adjacent surface. Fill surface imperfections including, but not limited to holes, surface damage, micro cracks, air holes, pop-outs, voids, and micro-pitting in finished work. Surface imperfections shall not be reasonably noticed from a distance standing 10 feet away or greater utilizing lighting conditions present after construction.
22. Concrete Dye Application: Provide two coats and per manufacturer’s printed instructions.
23. Densifier/Hardener Application: Per manufacturer’s printed instructions.
24. Honing: Hone surface equivalent to a finish using grinding equipment making parallel overlapping passes in one direction with sequential perpendicular passes. Finish to obtain maximum refinement for each increase in grit.
25. Polishing: Polish surface equivalent to a finish using polishing equipment making parallel overlapping passes in one direction with sequential perpendicular passes. Finish to obtain maximum refinement for each increase in grit. Final finish to reach Finished Gloss Level specified herein.
26. Joint Filler Application: As recommended in writing by manufacturer. Fully clean all joints of debris prior to application.
27. Sealer/Stain Protector Application: Per manufacturer’s printed instructions, apply two coats and buff between coats.
28. Floor Protection: Protect concrete topping slab surfaces as recommended in writing by manufacturer of concrete polishing products.

END OF SECTION 033543

**SECTION 044321 – INTERIOR ADHERED MASONRY VENEER AND STONE MASONRY**

1. Summary: Section Includes Interior Adhered Masonry Veneer Installation Systems.
2. Submittals: Product Data; Samples, and Closeout Maintenance Data: For each variety of adhered veneer, accessory, and manufactured product included in this section.
3. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
4. Cementitious Backer Boards: ANSI A118.9 and ASTM C 1325, 1/2 inch (12.7 mm) thick, Type A, in maximum lengths available to minimize end-to-end butt joints. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company; "PermaBase" Cement Board, or one of the following: Custom Building Products; Wonderboard. FinPan, Inc.; Util-A-Crete Concrete Backer Board or United States Gypsum Company; DUROCK brand cement board.
5. Installation Products: Basis of design products as follows are per Laticrete "MVIS" system. Subject to conformance with requirements comparable products by Custom Building Products and Mapei shall be considered.
6. Accessories for Tile Backer Boards: Tape: 4 inch (102 mm) wide polymer-coated (alkali resistant) mesh tape, Basis-of-Design product - National Gypsum Company; PermaBase Tape.
7. Laticrete Polymer Fortified Veneer Mortar: Laticrete MVIS Thin Brick Mortar **or** MVIS Hi-bond masonry veneer mortar (For "oversized" veneer units may also be used for "standard size" veneer units or MVIS veneer mortar (For "standard size" veneer units and for soffit locations. Preblended and bagged latex-portland cement mortar.
8. Pointing Mortar: Laticrete MVIS Pointing Mortar by Laticrete International, Inc.
9. Masonry Veneer Basis-of-Design Manufacturer/Product: Subject to compliance with requirements of this Section, provide stone veneer style, texture and color as indicated on Drawings or an equivalent product of the following: Boral Stone Products, LLC, Coronado Stone Products, Dutch Quality Stone, or Native Custom Stone.
10. Execution: Examine surfaces indicated to receive adhered veneer system, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry. Verify that wall substrates for adhered veneer system locations meet a maximum allowable horizontal deflection requirement of L/360. Proceed with installation only after unsatisfactory conditions have been corrected.
11. Protection: Prevent work from occurring on the opposite of walls to which adhered veneer systems are applied during and for 48 hours following installation of the stone.
12. Tile Backer Board Sheathing substrate over metal stud framing. Tape joints with 4" wide alkali-resistant mesh tape and Laticrete Masonry Veneer Mortar. Do not treat joints with gypsum or asphalt based compounds. Stagger vertical joints of the cementitious backer board. Locate joints over framing members. Offset vertical joints in cementitious backer board a minimum of one stud space from vertical joints in sheathing underneath. Offset joints in cementitious backer board a minimum of 8 inches from the corners of openings by "L" cutting cement board around openings.
13. Substrate Tolerances: Maximum deviation in plane: Not to exceed 1/4 inch in 10 feet, with not more than 1/16 inch variation in 1 foot.
14. Installation of Adhered Veneer Masonry Units: All surfaces should be between 40°F. and 90°F. and structurally sound, clean and free of all dirt, oil, grease, paint, concrete sealers or curing



- compounds. Prior to installation, ensure back of all adhered veneer units are clean of dust, laitance, loose concrete crumbs and any excess film that could impede bond.
15. Sort adhered veneer units before they are placed in wall to remove veneer units that do not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that are otherwise unsuitable for intended use.
  16. Key uniform layer of Veneer Mortar Tile Backer Board substrate. Comb additional mortar onto substrate with mortar manufacturer recommended notched trowel. Back butter veneer units to provide full bedding (100%) of the veneer. Place veneer units into the mortar and adjust to desired position, arranged in patterns as indicated on Drawings and per approved mockups. Provide control joints and sealant joints of widths and at locations indicated. Clean excess extruded mortar.
  17. Pointing: Allow installed adhered veneer system to cure for a minimum of 24 hours at 70 degrees F. Verify mortar joints are free of dirt and debris, dampen surface with water, and remove any water standing in joints. Proceed with work only when substrate temperature is between 40°F. and 90°F. Install pointing mortar to desired depth, ensuring mortar is forced into voids. Cure to "thumbprint" hardness and trowel, rake, or brush joint to match approved joint finish per mockup as selected by Interior Designer.
  18. Remove and replace adhered veneer units of the following description:
    - a. Broken, chipped, stained, or otherwise damaged adhered veneer units. Veneer units may be repaired if methods and results are approved by Interior Designer.
    - b. Defective joints.
    - c. Adhered veneer system not matching approved samples and mockups.
    - d. Adhered veneer system not complying with other requirements indicated.
    - e. Replace in a manner that results in adhered veneer system matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
  19. In-Progress Cleaning: Clean Adhered veneer system as work progresses. Remove mortar fins and smears before tooling joints.
  20. Final Cleaning: Clean completed adhered veneer system work after mortar is set in accordance with adhered veneer manufacturer's and mortar manufacturer's written recommended practices.
  21. Sealer: Apply penetrating stain resistant sealer per manufacturer's written instructions, and per approved mock-up panel.
  22. Excess Adhered Veneer Units: Stack excess adhered veneer units where directed by Owner for Owner's use.
  23. Stone Masonry: Cast stone slabs for cap trim as indicated on Finish Schedule.
    - a. Finish: As indicated.
    - b. Minimum Thickness: As indicated on Drawings.
    - c. Sealer: As specified herein and per approved mock-up.
  24. Mortar: As specified herein for adhered masonry veneer. Confirm mortars used will not stain stone per approved mock-up. Provide Type N White Masonry Cement mixed with white sand if staining occurs.

25. Cleaning: After mortar sets, brush down with stiff fiber brush, rinse with clear water.

END OF SECTION 044321



**SECTION 054000 - COLD-FORMED METAL FRAMING**

1. Summary: This section includes metal framing for interior wall locations. All interior metal framing, including cold formed metal framing and non-structural metal framing, shall be the Delegated Design responsibility of Contractor
2. Submittals: Product data, material certificates, and Delegated Design Engineering Documentation per Division 01 Section "Quality Requirements".
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following: AllSteel & Gypsum Products, Inc., ClarkDietrich Building Systems, MarinoWARE, or equal as approved by Interior designer.
4. Performance Requirements:
  - a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
  - b. Comply with AISI S230.
  - c. Comply with AWS D1.3.
  - d. Design Criteria: Except as may be specifically indicated otherwise, design and construct interior walls and partitions for maximum allowable deflection of L/240, except L/360 for walls and partitions where room-side finish is stone, tile, or wood panels; with L equal to height in inches, when subjected to uniformly distributed horizontal loads as follows: Typical Interior Partition: 5 pounds per square foot of wall surface.
5. Steel Sheet: ASTM A653, G40 (Z120) hot dip galvanized coating, or equivalent.
6. Steel Studs: C-shaped, with flange width of not less than 1-5/8 inches (41 mm). Minimum Base-Metal Thickness for typical steel stud construction: 25 gage, 0.018 inch (0.45 mm). Minimum Base-Metal Thickness for interior walls serving as a substrate for ceramic tile: 20 gage, 0.030 inch (0.762 mm).
7. Steel Joists: C-shaped, with flange width of not less than 1-5/8 inches (41 mm), minimum uncoated steel design thickness of 0.538 inch (1.37 mm), and of depths indicated.
8. Steel Track: U-shaped, minimum uncoated metal thickness same as studs or joists used with track, with flange widths of 1-1/4 inches (32 mm) for studs and 1-1/2 inches (38 mm) for joists, of web depths indicated.
9. Accessories: Fabricate from the same material and finish used for framing members, of manufacturer's standard thickness and configuration, unless otherwise indicated.
10. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities, calculated according to ICC-ES AC193 and ACI 318, greater than or equal to the design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
11. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
12. Mechanical Fasteners: ASTM C 1513, self-drilling, self-tapping, steel drill screws, with corrosion-resistant coating.
13. Install framing and accessories level, plumb, square, and true to line, and securely fastened, according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated. Cut framing members by sawing or shearing; do not torch cut. Fasten framing members by welding or screw fastening.
14. Erection Tolerances: Install cold-formed metal framing with a maximum variation of 1/8 inch in 10 feet (1:960) and with individual framing members no more than plus or minus 1/8 inch (3

mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

15. Studs: Install continuous top and bottom tracks securely anchored at corners and ends. Squarely seat studs against webs of top and bottom tracks. Space studs as indicated; set plumb, align, and fasten both flanges of studs to top and bottom tracks.
16. Joists: Install and securely anchor perimeter joist track sized to match joists. Install joists bearing on supporting framing, brace and reinforce, and fasten to both flanges of joist track.

END OF SECTION 054000

**SECTION 055000 – METAL FABRICATIONS**

1. Summary: This Section includes the following: Steel framing and supports for countertops, Steel framing and supports for applications where framing and supports are not specified in other Sections, and Shelf angles.
2. Submittals: Product Data and Shop Drawings.
3. 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.
4. Steel Plates, Shapes, and Bars: ASTM A 36 / A 36M.
5. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
6. Steel Tubing: ASTM A 500, Grade B, minimum 0.148 inch wall thickness, cold-formed steel tubing.
7. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
8. Slotted Channel Framing: Cold-formed steel channels complying with MFMA-4, 1-5/8 by 1-5/8 inches (41 by 41 mm) coated with rust-inhibitive, baked-on, acrylic enamel.
9. Fasteners: General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
10. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153.
11. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
12. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
13. Nonshrink, Nonmetallic Grout: complying with ASTM C 1107, as recommended by manufacturer for interior and exterior applications.
14. 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.
15. Fabrication: Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Form bent-metal corners to smallest radius possible without impairing work.
16. Weld corners and seams continuously: Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. At exposed connections, finish

exposed welds and surfaces smooth, with contour of welded surface matching that of adjacent surface.

17. Miscellaneous Framing and Supports: General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
18. Shelf Angles: Fabricate shelf angles from steel angles for attachment to concrete framing. Provide mitered and welded units at corners. Provide open joints in shelf angles at expansion and control joints.
19. Miscellaneous Steel Trim: Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
20. Steel and Iron Finishes: Galvanizing: Hot-dip galvanize items as indicated.
21. Specialty "Blackened Steel" Finish Over Structural Steel: Items as indicated on Drawings. Blackening Chemical Products: Provide products per one of the following per approved mockup: EPI Chemicals, Sur-Fin Chemicals, or equal as approved by Architect. Installers: Installation shall be by one of the following, or equal as approved by Architect: The Lee Quigley Company (Tom Stoub 281-358-9608) Basis-of-Design Installer, Raydeo enterprises, Inc. (Preston Byers 770-720-1100), or equal as approved by Architect.
22. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications: " Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
23. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
24. Specialty "Blackened Steel" Finish Over Structural Steel: Specialty "Blackened Steel" System: Install so as to match approved mockup samples, in accordance with manufacturer's written printed instructions, and the following: Steel Preparation: Scale-free, pickled hot rolled steel. Clean steel surfaces with degreasing agent. Scrub steel with abrasive material, rinse with clean water. Hand apply blackening chemical using multiple applications and highlighting between them until the desired color and consistency is achieved as approved by Architect. Spray apply clear lacquer protection in sheen as selected by Architect.
25. Installation: Provide anchorage devices and fasteners where needed to secure items to in-place construction. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack. Fit exposed connections accurately together to form hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

END OF SECTION 055000

**SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY**

1. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.
2. Preservative-Treated Materials: AWWPA U1; Use Category UC2. Use treatment containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
3. Fire-Retardant-Treated Materials: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test. Use Interior Type A for interior locations, unless otherwise indicated. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with design adjustment factors of not less than 0.85 for modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Identify with appropriate classification marking of a testing and inspecting agency acceptable to authorities having jurisdiction.
4. Provide fire-retardant treated materials for items within wall construction and items as indicated on Drawings.
5. Miscellaneous Dimension Lumber: Construction, or No. 2, Standard, Stud, or No. 3 grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.
6. Concealed Boards: Eastern softwoods, No. 3 Common: NELMA; or Mixed southern pine, No. 2: SPIB; with 19 percent maximum moisture content.
7. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel. Power-Driven Fasteners: CABO NER-272. For fasteners used in conjunction with treated wood, provide fasteners that are compatible with wood treatment.
8. Set miscellaneous rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
9. Securely attach miscellaneous rough carpentry to substrates, complying with the following: CABO NER-272 for power-driven fasteners. Table 2304.9.1, "Fastening Schedule," in the IBC.

END OF SECTION 061053





**SECTION 062000 - FINISH CARPENTRY**

1. Submittals: Samples for exposed wood, exposed woodwork, moldings and trim and fiberglass fabrications.
2. Lumber: DOC PS 20 and grading rules of inspection agencies certified by American Lumber Standards Committee Board of Review.
3. Softwood Plywood: DOC PS 1.
4. MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.
5. Interior Softwood Lumber Trim: C Select (Choice), eastern white, Idaho white, lodgepole, ponderosa, or sugar pine, Finish or 1 Common (Colonial) eastern white, Idaho white, lodgepole, ponderosa, or sugar pine, C Select white woods, or 1 Common white woods. Maximum Moisture Content: 19 percent.
6. Interior Hardwood Lumber Trim: Clear, kiln-dried, red oak, white maple, Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar.
7. Wood Moldings: WMMPA WM 4 made to patterns in WMMPA WM 12 from kiln-dried stock.
8. Softwood Moldings for Transparent Finish: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
9. Hardwood Moldings for Transparent Finish: Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar.
10. Moldings for Painted Finish: P-Grade Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, yellow poplar or primed medium-density fiberboard.
11. Cabinet Hardware and Accessories: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware," and where may be indicated otherwise on Drawings.
  - a. Refer to Finish Schedule for Metal Pulls, Trash Grommets and Liners
12. Shutters for Opaque Finish (EWS): Architectural Woodwork Standards Grade: Custom. Style: As indicated on Finish Schedule. Wood Species: As indicated on Finish Schedule. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide. Wood Moisture Content: 9 to 15 percent.
  - a. Refer to Division 09 Sections for 'Interior Painting'[and 'Intumescent Painting] section[s] for finishing of shutters.
13. Decorative Brackets (SF-04) and Running Trim (SF-05): Basis-of-Design: Vintage Woodworks, wood bracket and wood trim as indicated on Finish Schedule.
14. Installation: Condition interior finish carpentry in installation areas for 24 hours before installing. Prime and backprime lumber for painted finish exposed on the exterior. Cut to length and prime ends. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Scribe and cut to fit adjoining work. Refinish and seal cuts.
15. Install standing and running trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long except where necessary. Stagger joints in adjacent and related trim. Cope at returns and inside corners and miter at outside corners.

END OF SECTION 062000



**SECTION 063000 – ARCHITECTURAL FIBERGLASS FABRICATIONS**

1. Submittals: Shop Drawings: Include plans, elevations, sections, profiles, and details of dome sections. Illustrate dimensions, adjacent construction, materials, thickness, fabrications details, required clearances, field jointing, colors, finishes, methods of support, attachments, anchorage to substrates, integration of components, and list of part numbers that coordinate with labeled architectural fiberglass parts. Delegated Design Responsibility: Include calculations and stamped drawings by professional engineer registered in the state of dome installation, to meet state and local codes. Product Data: Submit product data and installation instructions. Samples: Submit minimum 3-inch x 5-inch samples in specified color, texture and finish when applicable.
2. Warrant architectural fiberglass dome to be free from defect due to materials and workmanship for one year.
3. Basis-of-Design Manufacturer: Architectural Fiberglass, Inc. (SF-10) “Architectural Fiberglass Reinforced Polymer (FRP) Decorative Self-Supporting Dome” for interior application. Fiberglass Finials (SF-11): Basis-of-Design: Architectural Fiberglass Inc., finial as indicated on Drawings of architectural fiberglass reinforced polymer fabrications. Molded Exterior Surface: U-V inhibited, NPG-ISO polyester gel coat, 18 to 22 mils thick. Color, texture and finish to match Architect’s sample. Barrier Coat: Class A finish, formulated backup polyester surface veil 18-20 mils thick.
4. Molded Exterior Surface: U-V inhibited, NPG-ISO polyester gel coat, 18 to 22 mils thick. Color, texture and finish to match Architect’s sample. Barrier Coat: Class A finish, specifically formulated backup polyester surface veil 18-20 mils thick. Back Up Laminate: Resin: Polyester resin to be fire retardant and meet Class 1 flame spread rating of 25 or less and smoke density under 450 without the use of antimony trioxide as characterized by the ASTM E-84 tunnel test at typical 1/8-inch glass mat laminate. General purpose resin will not be permitted. Filler: Add to resin matrix to minimize shrinkage, add stiffness, control opacity, add fire retardance, improve surface finish, minimize crazing, and control dimensional stability from weather extremes. Fiberglass Reinforcement: Type “E” fiberglass, glass cloth, matt and/or random chopped glass fibers. Glass content approximately 20% to 30%. Laminate Thickness: Nominal laminate to be minimum 3/16-inch thickness. Larger dome sections to be manufactured with additional core reinforcements and/or sandwich structure added as required for rigidity and structural integrity.
5. Fabrication: Dome to be fabricated with integral framing system without the need for additional skeleton framing after assembly. Dome sections to be formed with assembly bolting flanges with sufficient depth to provide structural integrity and to accommodate gaskets, fasteners, and sealant. Dome sections to be manufactured for proper panel-to-panel alignment and for weather-tight installation. Dome sections to be manufactured as a single unit spanning entire profile from base of dome to top of dome. Connection flanges to be reinforced with polywood or other treated rot-proof material for connection to building substrate. Dome sections to be factory pre-drilled, labeled, and pre-assembled for field reassembly.
6. Finish: Provide colored gel coat or Sherwin Williams Polane S Plus Polyurethane Enamel Coating as selected by Architect. Surface texture / exposed side shall be smooth or textured to match approved sample.
7. Tolerances: Part Thickness: + or – 1/8 inch. Gel Coat Thickness: + or – 2.5 mils. Length: + or – 1/8. Variation from Square: 1/8 inch. Hardware Location Variation: + or – 1/4 inch.

8. Anchors and Fasteners: Provide anchors, fasteners, gaskets, and accessories for installation of architectural fiberglass dome as recommended and approved by fiberglass fabrication manufacturer.
9. Pre-Installation Examination: Observe and verify field conditions that substrates are ready for installation of architectural fiberglass dome. Verify on-site dimensions with shop drawings, fit components to the structure. Verify that bearing surfaces are true and level. Verify that dome connection framing has been constructed to allow accurate placement, alignment and connection of architectural fiberglass dome to structure. Report discrepancies between design dimensions and field dimensions, which could adversely affect the dome installation, to the Architect. Do not proceed with installation of dome until discrepancies are corrected, or until installation requirements are modified and approved by the Architect. Beginning of installation means acceptance of existing conditions and fiberglass materials.
10. Installation: Install architectural fiberglass dome in compliance with manufacturer's printed instructions and approved shop drawings. Apply continuous run of sealant and expandable cellular foam gasket as recommended in manufacturer's instructions and approved shop drawings to the bolting flanges of all sections for weather-tight installation. Dome to be assembled on level surface and raised into place. Interior dome joints (when applicable) shall be finished with polyester body filler and fiberglass mesh tape. Joints to be filled, sanded, primed and painted for monolithic appearance.
11. Maximum offset from True Alignment: 1/4 inch in 20 feet. Maximum Variation from True Position: 1/2 inch in 20 feet.

END OF SECTION 063000

**SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS**

1. Submittals: Shop Drawings, Samples.
2. Fabricator Qualifications: 5 years of successful experience with plastic laminate cabinetry work similar to project's scope of work.
3. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating.
4. Architectural Cabinets: Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."
5. Plastic-Laminate Cabinets:
  - a. Custom grade.
  - b. Type of Construction: As detailed on Drawings.
  - c. Cabinet Door and Drawer Style: As detailed on Drawings.
  - d. Laminate Cladding: Shelves, countertop, backsplash and apron face, Grade HGS; other Horizontal surfaces, Grade HGL; postformed surfaces, Grade HGP; other vertical surfaces, Grade VGS; edges, Grade HGS; semiexposed surfaces, thermoset decorative panels. Drawer Sides and Backs: Solid hardwood or Thermoset decorative panels.
  - e. Drawer Bottoms: Hardwood plywood or Thermoset decorative panels.
6. Materials: Wood Moisture Content: 8 to 13 percent. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
7. High-Pressure Decorative Laminate: NEMA LD 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: Formica Corporation. Lamin-Art, Inc. Nevamar; a Panolam Industries International, Inc. brand. Pionite; a Panolam Industries International, Inc. brand. Wilsonart International Holdings, Inc.
8. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware." Provide hardware as follows, unless indicated otherwise on Drawings:
9. Decorative Hardware: Door Pulls (DH-04): Richelieu Hardware, in model as indicated on Finish Schedule, Finish: Brushed Nickel. Grommet and Liner (DH-02, DH-03): Doug Mockett, in model as indicated on Finish Schedule. Finish: As indicated on Finish Schedule.
10. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
11. Catches: Magnetic catches, BHMA A156.9, B03141.
12. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112, as selected by Owner / Interior designer.
13. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
14. Drawer Slides: BHMA A156.9, B05091. Box Drawer Slides: Grade 1HD-100. File Drawer Slides: Grade 1HD-200. Pencil Drawer Slides: Grade 2. Keyboard Slides: Grade 1HD-100. Trash Bin Slides: Grade 1HD-100.
15. Drawer Locks: BHMA A156.11, E07041.

16. Exposed Hardware Finishes: Comply with BHMA A156.18 for BHMA code number indicated.  
Finish: As designated on Drawings.
17. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated where required by code or designated on Drawings; Softwood or hardwood lumber, kiln dried to 15 percent moisture content.
18. Complete fabrication to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
19. Before installation, condition cabinets to average prevailing humidity conditions in installation areas. Install cabinets to comply with referenced quality standard for grade specified. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts. Anchor cabinets to anchors or blocking built into or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

END OF SECTION 064116

**SECTION 073113 - ASPHALT SHINGLES (SF-01)**

1. Submittals: Product Data for Asphalt shingles.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Atlas Roofing Corp., GAF, Certainteed or equal as approved by Architect.
  - a. Glass-Fiber-Reinforced Asphalt Shingles: Three-tab-strip type, multidimensional.
  - b. Hip and Ridge Shingles: Standard units.
  - c. Color and Blends: As selected by Architect from manufacturer's full range.
3. Installation:
  - a. Install asphalt shingles in accordance with manufacturer's written instructions.
  - b. Valleys: Granular surfaced, open.

END OF SECTION 073113





**SECTION 074646 - FIBER-CEMENT SIDING**

1. Submittals: Product Data, Samples, and ICC-ES evaluation reports.
2. Warranties: Manufacturer's standard from in which siding manufacturer agrees to repair or replace siding that fails in materials or workmanship within 30 years. Failures include, but are not limited to, cracking, deforming, or otherwise deteriorating beyond normal weathering.
3. Fiber-Cement Siding: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84. Factory primed and field painted.
4. Basis-of-Design Product: Subject to compliance with requirements, provide James Hardie, Inc.; product type as designated on Drawings or a comparable product by one of the following: Allura. Nichiha Fiber Cement.
5. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186.
6. Patterns, textures and sizes: As indicated on Drawings or as selected by Owner / Architect.
7. Fiber-Cement Soffit: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84. Factory primed. Manufacturer: Same as Fiber Cement Siding Manufacturer. Patterns, textures and sizes: As indicated on Drawings or as selected by Owner / Architect. Provide unperforated soffit unless otherwise indicated. Continuous Soffit Vents: As designated on drawings.
8. Decorative Accessories: Provide the following fiber-cement decorative accessories where indicated: Corner posts. Door and window casings. Fasciae. Moldings and trim.
9. Fabrication: All fiber-cement materials/products shall have smooth (sanded) cut edges unless noted otherwise.
10. Installation: Install fiber-cement siding and soffit and related accessories. Install fasteners no more than 24 inches (600 mm) o.c.

END OF SECTION 074646



**SECTION 079200 - JOINT SEALANTS**

1. Submittals: Product Data and color Samples.
2. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
3. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
4. Low Modulus Stain Resistant Silicone Sealant for Interior Joints:
  - a. Acceptable Products: Dow; Dowsil 756. Pecora Corporation; 864. Tremco, Inc.; SpecTrem 2.
  - b. Type: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
5. Ultra-Low Modulus, Silicone Sealant for Interior Joints: Concrete-to-Concrete, Masonry-to-Masonry, Exterior Insulation and Finish Systems (EIFS), and for joints between combinations of these materials:
  - a. Acceptable Products: Dow; Dowsil 790. GE Construction Sealants; Momentive Performance Materials Inc.; GE SCS 2700. Pecora C Corporation; 890. Tremco, Inc.; SpecTrem 1.
  - b. Type: Single-Component, low modulus silicone rubber, ASTM C 920, Type S, Grade NS, Class 100-50. Stain Test Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
6. Medium Modulus Silicone Sealant for Interior Joints at Perimeter of Aluminum Framing Systems:
  - a. Acceptable Products: Dow; Dowsil 795. GE Construction Sealants; Momentive Performance Materials Inc.; GE SCS 2000. Pecora Corporation; 895. Tremco, Inc.; SpecTrem 2.
  - b. Type: Single-Component, medium-modulus silicone rubber, meeting ASTM C 920, Type S, Grade NS, Class 50. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
7. Interior Single-Component Mildew-Resistant Silicone Bath Sealant for Interior joints in conjunction with vanities, fixtures and tile finishes:
  - a. Acceptable Products: Dow; Dowsil 786 Mildew Resistant. GE Silicones; Sanitary SCS1700. Pecora Corp.; #898 Silicone Sanitary Sealant.
  - b. Type: Silicone rubber; mildew and stain resistant, ASTM C 920, Types S, Grade NS, Class 25, for use NT.
8. Multi-Component Polyurethane Sealant for Interior Pedestrian Locations:
  - a. Acceptable Products: Pecora Corporation; Dynatred. Tremco; Vulkem 227. Tremco, Inc.; HPL.
  - b. Type: Two-component polyurethane, ASTM C 920, Type M, Grade NS, Class 25; self-leveling for flat surfaces and non-sag for sloped surfaces.
9. Acrylic Sealants for Interior joints at perimeter of windows and hollow metal framing. Interior concealed bedding joints and thresholds:
  - a. Acceptable Products: Bostik Findley; Chem-Calk 600. Tremco; Mono 555.

- b. Type: One-part acrylic polymer sealant. Colors: Standard colors as selected by Architect.
10. Paintable Acrylic-Latex Caulking Compound for Interior Locations:
- a. Acceptable Products: Bostik Findley; Chem-Calk Painter's Calk. Pecora Corp.; AC-20 Acrylic-Latex. BASF Sonneborn Sonolastic Sonolac. Tremco, Inc.; Tremflex 834.
  - b. Type: Flexible, paintable, non-staining, non-bleeding acrylic emulsion.
11. Acoustical Sealant for Exposed Interior Joints:
- a. Acceptable Products: ChemRex, Inc.; Contech Brands, PL Acoustical Sealant. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
  - b. Type: Non-sag, paintable, non-staining latex sealant complying with ASTM C834 and is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
12. Acoustical Sealant for Concealed Interior Joints:
- a. Acceptable Products: G.E. Corporation; Pensil 100/300 (fire-rated sealant). G.E. Corporation; Sil Pruf Sealant. Hilti; FS-601 Firestop Sealant (fire-rated sealant). Pecora Corporation; BA-98. Tremco, Inc.; Tremco Acoustical Sealant. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
  - b. Type: Non-drying, non-hardening, non-skinning, non-staining, gunnable synthetic rubber sealant for sealing interior concealed joints to reduce airborne sound transmission.
13. Provide sealant backings of materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
14. Open Cell Backer Rod: Open cell polyurethane foam (To be used at interior conditions only).
15. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.
16. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
17. Installation: Comply with ASTM C 1193. Install sealant backings to support sealants during application and to produce cross-sectional shapes and depths of installed sealants that allow optimum sealant movement capability. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal perimeters, control joints, openings, and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions. Comply with ASTM C 919.

END OF SECTION 079200

**SECTION 081113 - HOLLOW METAL DOORS AND FRAMES**

1. Submittals: Product Data, Shop Drawings.
2. Hollow Metal Doors and Frames: Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Ceco Door; ASSA ABLOY.
  - b. Curries Company; ASSA ABLOY.
  - c. Habersham Metal Products Company.
  - d. Jeld-Wen.
  - e. Mesker Door Inc.
  - f. Steelcraft; an Ingersoll-Rand brand.
3. Doors: Complying with SDI A250.8 for level and model and SDI A250.4 for physical-endurance level indicated, 1-3/4 inches thick unless otherwise indicated.
  - a. Interior Doors: Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
4. Frames: ANSI A250.8; conceal fastenings unless otherwise indicated.
  - a. Interior Frames: Level 1, 0.042-inch- Level 2, 0.053-inch- minimum thickness for Level 2 steel doors; Face welded. Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Where frames are designated to be allowed to be adjustable metal frames, fabricate frames with mitered or coped corners.
5. Door Silencers: Three on strike jambs of single-door frames and two on heads of double-door frames.
6. Grout Guards: Provide where mortar might obstruct hardware operation.
7. Prepare doors and frames to receive mortised and concealed hardware according to SDI A250.6 and BHMA A156.115.
8. Reinforce doors and frames to receive surface-applied hardware. Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
9. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, suitable for exposed applications.
10. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, free of scale, pitting, or surface defects.
11. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, G60 or A60.
12. Frame Anchors: Not less than 0.042 inch thick.
13. Prime Finish: Manufacturer's standard, factory-applied coat of lead- and chromate-free primer complying with SDI A250.10 acceptance criteria.
14. Install hollow metal frames to comply with SDI A250.11. Fire-Rated Frames: Install according to NFPA 80. Install doors to provide clearances between doors and frames as indicated in SDI A250.11.
15. 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. Use galvanizing repair paint for metallic coated surfaces.
16. Concealed Frame: 18 gauge galvanized steel, one-piece with perforated flanges. Invisible Door Hinges: As indicated on Drawings. Door Strikes: As indicated on Drawings. Install concealed frame in compliance with manufacturer's instruction and approved submittals.

END OF SECTION 081113



**SECTION 081416 - WOOD DOORS**

1. Submittals: Samples for door finishes.
2. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following: Warping (bow, cup, or twist) more than ¼ inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - a. Warranty Period for Solid-Core and Mineral Core Interior Doors: Life of installation.
  - b. Warranty Period for Hollow-Core Interior Doors: Two year(s) from date of Substantial Completion.
  - c. Warranty Period for MDF Interior Doors: Life of installation.
3. Solid Core Doors (Interior Locations): Basis-of Design Manufacturer and Type: Mohawk Premium 2000. Other Acceptable Manufacturers: Masonite Architectural, Oshkosh Architectural Door Co, VT Industries, Eggers series. Others as may be approved by Architect. Core: Particleboard. Face Veneers: Stain Finish: Where indicated on Drawings. Book match veneers across door face, full length. Veneers for doors in public spaces shall match those of adjacent wood surfaces. Painted Finish: Medium Density Overlay (MDO) veneer door or AWI Grade A, Birch or Beech, rotary-cut; over standard thickness hardwood veneers; sanded and primed for field painting. Stiles: Stain Finish: Match face veneers. Factory preseal top and bottom edges. Painted Finish: Sanded and primed for field painting. Quality Standard: WDMA I.S.1-A, performance grade "Heavy Duty" unless indicated otherwise.
4. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
5. Fire-Rated Wood Doors: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at positive pressure according to NFPA 252 or UL 10C. Where indicated, provide doors that have a temperature rise rating of 450 deg F (250 deg C). Provide core specified or mineral core as needed to provide fire-protection rating indicated.
6. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
7. Particleboard-Core Doors: Provide blocking in particleboard cores or provide structural composite lumber cores instead of particleboard cores for doors with exit devices or protection plates.
8. Mineral-Core Doors: Provide the following: Composite blocking where required to eliminate through-bolting hardware. Laminated-edge construction. Formed-steel edges and astragals for pairs of doors.
9. Light Frames: Wood beads of same species as or species compatible with door faces. At fire-rated doors provide wood-veneered beads or factory-painted steel frames approved for use in doors of fire-protection rating indicated.
10. Factory-fit doors to suit frame-opening sizes indicated and to comply with clearances specified.
11. Factory-machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.



12. Cut and trim openings to comply with referenced standards. Trim light openings with moldings indicated. Factory-install glazing in doors indicated to be factory finished. Factory-install louvers in prepared openings.
13. Factory-finish interior doors indicated for transparent finish with stain and manufacturer's standard finish complying with WDMA TR-4, conversion varnish or WDMA TR-6, catalyzed polyurethane for grade specified for doors. Sheen: Satin.
14. Factory-finish interior doors indicated for opaque finish with manufacturer's standard finish complying with WDMA OP-4, conversion varnish or WDMA OP-6, catalyzed polyurethane for grade specified for doors. Sheen: Semigloss.
15. Install doors to comply with manufacturer's written instructions and WDMA I.S.1-A, and as indicated. Install fire-rated doors to comply with NFPA 80. Install smoke- and draft-control doors according to NFPA 105. Align doors in frames with uniform clearances and bevels.
16. Clearances: As follows unless otherwise indicated: 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. 1/4 inch (6.4 mm) from bottom of door to top of threshold. Comply with NFPA 80 for fire-rated doors.

END OF SECTION 081416

**SECTION 083113 – ACCESS DOORS AND FRAMES**

1. Submittals: Product Data.
2. Performance Requirements: Fire-Rated Access Doors and Frames: Labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing per the following:
  - a. Vertical Access Doors: NFPA 252 or UL 10B.
  - b. Horizontal Access Doors and Frames: NFPA 288.
3. Access Doors (for Typical Locations): Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following: Bar-Co, Inc. Div.; Alfab, Inc., J. L. Industries, Inc., Karp Associates, Inc., Milcor Inc., Nystrom, Inc., Williams Bros. Corporation of America (The).
  - a. Types: As required by substrates. Non-Fire-Rated Access Doors in Gypsum Wallboard Work: Flush type with perforated frame flanges for finishing with joint compound.
  - b. Construction: Steel Units: Minimum 14 gauge steel sheet for doors; 16 gauge for frames; prime painted. Fire-Rated Units: Minimum 22 gauge steel inside and outside door faces; box construction; filled with insulation; 16 gauge frames; prime painted.
  - c. Hardware: Non-Fire-Rated Units: Manufacturer's standard concealed hinges allowing 175 degree operation and screwdriver operated cam lock in non-public areas and keyed cylinder lock in public areas. Fire-Rated Panels: Manufacturer's standard continuous piano hinges, self-closing mechanism, interior release and cylinder lock.
4. Access Doors (for Gypsum Board Ceilings): Basis-of-Design Manufacturer/Product: Karp Associates, Inc., FG Glass Fiber Reinforced Gypsum Ceiling Access Doors, or similar products of one of the following other manufacturers: Metropolitan Door Industries; "Stealth" Access Panels. Others as may be approved by the Interior designer.
  - a. Types: Glass Fiber Reinforced Gypsum (GFRG) panels and frames designed for adjacent gypsum board paneling to be mudded in to frame for a seamless appearance, with tapered edge for gypsum board tape joint.
5. Fabrication: Provide access door and frame assemblies manufactured as integral units ready for installation. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed. Apply factory coat of rust-resistant primer paint to exposed steel surfaces not galvanized.
6. Installation: Review locations as to be installed in public locations with Interior designer prior to installation. Install access doors and panels accurately in position. Adjust hardware and door and panels for proper operation. Install fire-rated access doors and panels according to NFPA 80.

END OF SECTION 083113



**SECTION 084113 –ALUMINUM-FRAMED GLAZING SYSTEMS**

1. Summary: Aluminum Framed Glazing Systems for interior applications.
2. Submittals: Product Data, Shop Drawings, color Samples, and Maintenance Data. For entrance doors, include hardware schedule. Delegated-Design Submittal Calculations: Structural calculations, certified by a professional engineer in the State of Project Location, indicating all members, glass and anchorages capable of withstanding specified loads. Coordinate calculation submittal with Shop Drawing submittals.
3. Structural Performance: Design, engineer, fabricate, and install aluminum-framed storefronts to withstand structural loads indicated. Limit deflection of framing members normal to wall plane to 1/175 of clear span or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less. Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Kawneer North America, an Alcoa company; Vistawall Architectural Products; The Vistawall Group; an OldCastle Glass company, YKK AP America Inc.
5. Mullion Profile: Interior Storefront - 1-3/4" x 4" unless indicated otherwise on Drawings.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 (ASTM B 209M) sheet; ASTM B 221 (ASTM B 221M) extrusions.
7. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads. Construction: Nonthermal at interior locations.
8. Doors: 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Provide snap-on, extruded-aluminum glazing stops and preformed gaskets. Door Design: As indicated on Drawings. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane. Interior Doors: Provide BHMA A156.16 silencers, three on strike jamb of single-door frames and two on head of double-door frames. Maximum Force for Opening Doors: 5 lbf for interior doors. Accessible Sills: Provide accessible sills in accordance with applicable accessibility codes, compliance with ADA, and local jurisdiction code requirements for sill height and clear opening width. Hardware: As specified in Section 087100 "Door Hardware."
9. Glazing: Comply with Section 088000 "Glazing,". Tempered glass typical unless noted otherwise. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
10. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Use concealed fasteners except for application of door hardware. Sound Transmission Control Materials: Provide mullion closure to match finish of base building window system as indicated on Drawings or a comparable product by one of the following manufacturers: Emseal Joint Systems or Mull-It-Over Products.
11. Fabrication: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory-assemble components to greatest extent possible. Disassemble

components only as necessary for shipment and installation. Door Framing - Reinforce to support imposed loads. Factory-assemble door and frame units and factory-install hardware to greatest extent possible. Reinforce door and frame units for hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.

12. Aluminum Finish for Interior Locations: Class II, clear anodic finish; complying with AAMA 611.
13. Installation: Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer or by applying sealant or tape recommended by manufacturer.
14. Install components per manufacturer's written instructions to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior. Set continuous sill members and seal to existing construction as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
15. Install framing components true in alignment with established lines and grades to the following tolerances: Variation from Plane - Limit to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length. Alignment - For surfaces abutting in line, limit offset to 1/16 inch (1.5 mm). For surfaces meeting at corners, limit offset to 1/32 inch (0.8 mm). Diagonal Measurements - Limit difference between diagonal measurements to 1/8 inch (3 mm).
16. Install doors without warp or rack. Adjust doors and hardware to provide tight fit at contact points and smooth operation.
17. Pivot Doors: Glass doors with center pivot hardware as indicated on Drawings.

END OF SECTION 084113

**SECTION 084126 - ALL-GLASS PARTITIONS**

1. Submittals: Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system with swinging entrance doors.
2. Shop Drawings: For all-glass storefronts and swinging entrance doors. Include plans, elevations, and sections. Include details of fittings and glazing.
3. Samples: Metal Finishes: 6-inch- (150-mm-) long sections of rail fittings. Glass: 6 inches (150 mm) square, showing exposed-edge finish.
4. Special Warranty: Manufacturer and Installer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following: Structural failures including excessive deflection or air infiltration. Deterioration of metals, metal finishes, and other materials beyond normal weathering. Warranty Period: Two years from date of Substantial Completion.
5. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
6. Structural Loads: Deflection Limits: Deflection normal to glazing plane is limited to 1 inch (25 mm) 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller.
7. Manufacturers: Basis-of-Design C.R. Laurence Co, Inc., brushed stainless steel U-Channel, nominal 1-3/4" x 1-3/4", "roll-in" top load gasket Dorma; Pure Avanti Systems; Solare Acoustic Single Glazed Partition System, or subject to compliance with requirements, equal product as approved by Interior designer.
  - a. Manual swinging all glass entrance doors.
  - b. Anodized aluminum frame and fittings.
  - c. Hardware: Manufacturer's standard door hardware. Swinging door opening force shall not be more than 5 lbf (22.2N) to fully open the door.
8. Anchors and Fastenings: Concealed.
9. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials. Class 1: Clear monolithic. Thickness: 1/2 inch (13 mm) minimum, and as required for structural performance. Exposed Edges: Machine ground and flat polished. Butt Edges: Flat ground.
10. Butt-Glazing Sealants: Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses NT, G, and A.
11. Factory assemble components and factory install hardware and fittings to greatest extent possible.
12. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

13. Install all-glass systems and associated components according to manufacturer's written instructions. Set units level, plumb, and true to line, with uniform joints. Maintain uniform clearances between adjacent components.
14. Install butt-joint sealants according to manufacturer's instructions.

END OF SECTION 084126

**SECTION 084514 – INTERIOR ALUMINUM, FABRIC, AND GLAZED AWNINGS**

1. Section includes: Delegated Design, fabrication, and installation of decorative aluminum, fabric canopy system (bandshell) and glazed awnings for interior locations.
2. Submittals: Product Data, Shop Drawings, Samples, and Maintenance Data. Verify fabric meets minimum engineering requirements. Delegated design calculations with stamp and seal of Professional Engineer licensed in state of project location.
3. Deflection Limits for Overhead Panel Assemblies: Limited to 1/120 of clear span for each assembly component.
4. Installer Qualifications: Minimum 5 years of documented experience with work of similar scope and complexity required by this Project.
5. Basis-of-Design Manufacturer: Manufacturer [as used for as-built installation at Junior Achievement Discovery Center at Gwinnett County], or subject to conformance with requirements, comparable products as approved by Architect.
6. Delegated Design: Engage a qualified professional engineer to design tensioned fabric canopy system.
7. Aluminum Framing Systems: Components: One piece, extruded aluminum. Aluminum Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
8. Aluminum Finishes: Baked-Enamel or Powder-Coat Finish: AAMA 2603. Color and Gloss: As selected by Architect from manufacturer's full range.
9. Awning Fabrics: Acceptable Fabric Manufacturers: , Ferrari Textiles, Saint Gobain, Seaman Corporation, SEFAR. Fabric properties: Fabric thickness and tensile strength: Must meet engineering requirements with a safety factor of five. Color: To be selected from the manufacturer's standard range of available colors. Flame-Resistance Ratings: Passes NFPA 701. Reinforce wear points and hardware attachment points with webbing.
10. Plastic Glazing General: Comply with published instructions of plastic glazing manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated. See this publication for definitions of glazing terms not otherwise defined in this Section or in other referenced standards.
11. Plastic Glazing: Transparent acrylic sheet; ASTM D 4802, Finish 1 (smooth or polished), Type UVF (UV filtering). Nominal Thickness: 0.177 inch (4.5 mm) minimum. Color: Colorless. Combustibility Class: CC2.
12. Awning and Tensioned Fabric Canopy (Bandshell) Fabrication: Frames: Preassemble awning frames in the shop to greatest extent possible. Install awnings/tensioned fabric securely connected to supports, free of rack, and in proper relation to adjacent construction. Attach tensioned fabric to frames as recommended by fabricator and Delegated Design Engineer.to ensure tight, wrinkle-free fit of fabric to frame. Metals in contact with fabric shall be coated as recommended in writing by fabric manufacturer.
13. Installation: Install components plumb and true in alignment with established lines and elevations.

END OF SECTION 084514





**SECTION 085113 –ALUMINUM WINDOWS**

1. Summary: Aluminum windows includes fixed aluminum windows for exterior locations.
2. Submittals: Product Data, Shop Drawings, color Samples, and Maintenance Data. Delegated-Design Submittal Calculations: Structural calculations, certified by a professional engineer in the State of Project Location, indicating all members, glass and anchorages capable of withstanding specified loads. Coordinate calculation submittal with Shop Drawing submittals.
3. Performance Requirements: Design, engineer, fabricate, and install aluminum windows to withstand structural loads indicated. Product Standard: AAMA/WDMA/CSA 101/I.S.2/A440. Minimum Performance Class: AW. Minimum Performance Grade: 45. Thermal Transmittance: 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) maximum.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Kawneer North America, an Alcoa company; EFCO Corporation, YKK AP America Inc.
5. Window Types: As indicated on Drawings.
6. Construction: Provide units with a concealed, thermal break.
7. Finish: Fluoropolymer two-coat coating system complying with AAMA 2605.
8. Trim: Provide indicated trim, matching material and finish of frame members.
9. Glaze units with clear, low-E-coated, argon-filled, sealed insulating glass, complying with Section 088000 "Glazing."
10. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 (ASTM B 209M) sheet; ASTM B 221 (ASTM B 221M) extrusions.
11. Glazing: Comply with Section 088000 "Glazing,". Tempered glass typical unless noted otherwise. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
12. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding.
13. Installation: Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer or by applying sealant or tape recommended by manufacturer.
14. Install components per manufacturer's written instructions to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior. Set continuous sill members and seal to existing construction as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
15. Clean glass and aluminum surfaces immediately after installing windows. Remove nonpermanent labels from glass surfaces.

END OF SECTION 085113



**SECTION 085210 – INTERIOR WOOD WINDOWS**

1. Section includes wood windows for interior applications.
2. Submittals: Product Data for each type of product, shop drawings and samples.
3. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
4. Wood Window Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: Jeld-Wen, Inc., Marvin Windows and Doors, Pella Corporation, or equal as approved by Architect.
5. Operating Types: As indicated on Drawings.
6. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated. Finish: Manufacturer's standard factory-prime coat.
7. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3. Kind: Fully tempered.
8. Glazing System: Manufacturer's standard factory-glazing.
9. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
10. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.
11. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows. Glaze wood windows in the factory.
12. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
13. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.
14. Installation: Comply with manufacturer's written instructions for installing windows, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
15. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support.
16. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
17. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085210



**SECTION 087100 - DOOR HARDWARE****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following:
1. Hinges
  2. Spring hinges
  3. Key control system
  4. Lock cylinders and keys
  5. Lock and latch sets
  6. Bolts
  7. Exit devices
  8. Push/Pull units
  9. Closers
  10. Overhead holders
  11. Miscellaneous door control devices
  12. Door trim units
  13. Protection plates
  14. Weatherstripping for exterior doors
  15. Sound stripping for interior doors
  16. Automatic drop seals (door bottoms)
  17. Astragals or meeting seals on pairs of doors
  18. Thresholds
- C. Related Sections: The following Sections contain requirements that relate to this Section:
1. Section 08 11 13: Hollow Metal Doors and Frames
  2. Section 08 14 00: Wood Doors
  3. Section 08 33 23: Coiling Doors
  4. Section 08 41 13: Aluminum-Framed Entrances and Storefronts
  5. Division 26: Electrical
  6. Division 28: Electronic Safety and Security

## 1.3 REFERENCES

- A. Standards of the following as referenced:
1. American National Standards Institute (ANSI)
  2. Door and Hardware Institute (DHI)
  3. Factory Mutual (FM)
  4. National Fire Protection Association (NFPA)
  5. Underwriters' Laboratories, Inc. (UL)
    - a. UL 10B - Fire Tests of Door Assemblies
    - b. UL 10C – Positive Pressure Test of Fire Door Assemblies
    - c. UL 305 – Panic Hardware
    - d. UL 1784 – Air Leakage of Door Assemblies
  6. Warnock Hersey
- B. Regulatory standards of the following as referenced:
1. Department of Justice, Office of the Attorney General, *Americans with Disabilities Act*, Public Law 101-336 (ADA).
  2. CABO/ANSI A117.1: *Providing Accessibility and Usability for Physically Handicapped People*, 2017 edition.
  3. NFPA 70, National Electric Code
  4. NFPA 101, 2018 edition with Georgia Amendments
  5. NFPA 105, Smoke and Draft Control Door Assemblies
  6. IBC, 2018 edition
  7. IFC, 2018 edition

## 1.4 SYSTEM DESCRIPTION

- A. Refer to applicable “Headings” for system description for electric and electro-pneumatic hardware products.

## 1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements. For items other than those scheduled in the “Headings” of Section 3, provide catalog information for the specified items and for those submitted.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into vertical format “hardware sets” indicating complete designations of every item required for each door or opening. Use specification Heading numbers with any variations suffixed a, b, etc. Include the following information:
    - a. Type, style, function, size, and finish of each hardware item.
    - b. Name and manufacturer of each item.

- c. Fastenings and other pertinent information.
  - d. Location of each hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
  - e. Explanation of all abbreviations, symbols, and codes contained in schedule.
  - f. Mounting locations for hardware.
  - g. Door and frame sizes and materials.
  - h. Keying information.
  - i. Cross-reference numbers used within schedule deviating from those specified.
    - 1) Column 1: State specified item and manufacturer.
    - 2) Column 2: State prior approved substituted item and its manufacturer.
2. Furnish complete wiring diagrams, riser diagrams, elevation drawings and operational descriptions of electrical components and systems, listed by opening in the hardware submittals. Elevation drawings shall identify locations of the system components with respect to their placement in the door opening. Operational descriptions shall fully detail how each electrical component will function within the opening, including all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval. Supply a copy with delivery of hardware to the jobsite and another copy to the Owner at the time of project completion.
3. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule. Provide hardware for all doors shown on the plans and door schedule. Should no hardware set be indicated provide hardware to match similar doors.
4. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- D. Provide samples if requested of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.
- E. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- F. Contract closeout submittals:
1. Operation and maintenance data: Complete information for installed door hardware.
  2. Warranty: Completed and executed warranty forms.



**1.6 QUALITY ASSURANCE**

- A. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced Architectural Hardware Consultant (AHC) who is available for consultation to Owner, Architect, and Contractor, at reasonable times during the course of the Work.
- C. Coordination Meetings:
  - 1. Contractor to set up and attend the following:
    - a. Lock distributor to meet with the Owner to finalize lock functions and keying requirements and to obtain final instructions in writing.
    - b. Lock distributor and lock, closer and exit device manufacturer to meet with the installer prior to beginning of installation of door hardware. Instruct installer on proper installation of specified products.
  - 2. General Contractor to set up and attend the following:
    - a. Meet with the Owner, General Contractor, Supplier, electrical and security contractors to coordinate all electrical hardware items. Supplier to provide riser diagrams, elevation drawings, wiring diagrams and operational descriptions as required by the General and sub-contractors.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not. All hardware to comply with State and local codes and UL 10C.
  - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".

**1.7 PRODUCT HANDLING**

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

## 1.8 WARRANTY

- A. Special warranties:
  - 1. Door Closers: Ten year period
  - 2. Exit Devices: Three year period
  - 3. Cylinders: Three year period
  - 4. Locks: Ten Year period

## 1.9 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions that are packed in hardware items for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

(\*Denotes manufacturer referenced in the Hardware Headings)

- A. Hinges:
  - 1. Acceptable manufacturers:
    - a. Ives\* 5BB1 / 5BB1HW
    - b. Stanley FBB179 / FBB199
    - c. McKinney TA2714 / TA3786
  - 2. Characteristics:
    - a. Templates: Provide only template-produced units.
    - b. Screws: Provide Phillips flat-head screws complying with the following requirements:
      - 1) For metal doors and frames install machine screws into drilled and tapped holes.
      - 2) For wood doors and frames install threaded-to-the-head wood screws.
      - 3) For fire-rated wood doors install #12 x 1-1/4 inch, threaded-to-the-head steel wood screws.
      - 4) Finish screw heads to match surface of hinges or pivots.
    - c. Hinge pins: Except as otherwise indicated, provide hinge pins as follows:
      - 1) Out-Swing Exterior Doors: Non-removable pins.
      - 2) Out-Swing Corridor Doors with Locks: Non-removable pins.
      - 3) Interior Doors: Non-rising pins.
      - 4) Tips: Flat button and matching plug. Finished to match leafs.

- d. Size: Size hinges in accordance with specified manufacturer's published recommendations.
  - e. Quantity: Furnish one pair of hinges for all doors up to 5'-0" high. Furnish one hinge for each additional 2-1/2 feet or fraction thereof.
- B. Cylinders:
- 1. Acceptable manufacturers:
    - a. Best\* match existing key system
  - 2. Characteristics:
    - a. Review the keying system with the Owner and provide the type required (master, grandmaster or great-grandmaster).
    - b. Equip locksets with interchangeable core cylinders. Furnish black plastic construction core during construction phase. Owner to provide and install permanent cores.
    - c. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
    - d. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
      - 1) Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."
    - e. Key Material: Provide keys of nickel silver only.
    - f. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, 5 grandmaster keys for each grandmaster system, 10 construction master keys and 5 control keys for interchangeable core series and 5 extractor tools.
      - 1) Furnish 200 extra blank for each keyway used.
      - 2) Furnish construction master keys to General Contractor.
      - 3) Deliver keys to Owner.
  - 3. Locksets, Latchsets, Deadbolts:
    - a. Falcon MA/W Series\*
    - b. Schlage L9000/AL Series
    - c. Stanley 45H/73K Series
  - 4. Mortise locks and Latchsets: as scheduled.
    - a. Chassis: Cold-rolled steel, handing, field-changeable with disassembly.
    - b. Latchbolts: 3/4" throw stainless steel anti-friction.
    - c. Lever Trim: Through-bolted, accessible design, cast or solid rod lever.
    - d. Thumbturns: Accessible design not requiring pinching or twisting motions to operate.
    - e. Deadbolt: Stainless steel 1" throw.
    - f. Electric operation: Manufacturer-installed continuous duty solenoid.
    - g. Strikes: 16 gage curved stainless steel, bronze or brass with 1" deep box construction.
    - h. Scheduled Lock Series and Design: MA Series, Sutro- Gala (SG) lever trim .
    - i. Certifications: ANSI A156.2, Series 4000, Grade 1.

5. Deadbolts: as scheduled. Rotating cylinder trim rings of attack-resistant design. Mounting plates and actuator shields of plated cold-rolled steel. Mounting screws of 1/4" dia. steel and protected by drill-resistant ball bearings. Steel alloy deadbolt with hardened steel roller. Strike with 1/8" thick strike re-enforcer and two 3" long screws. ANSI A156.5, 1992 Grade 1 certified.
- C. Exit Devices:
1. Acceptable manufacturers:
    - a. Falcon 24/ 25\*
    - b. Von Duprin 35A, 98 series
  2. Characteristics:
    - a. Exit devices to be UL Listed for life safety. Exit devices for fire rated openings to have "UL" labels for "Fire Exit Hardware."
    - b. Exit devices mounted on labeled wood doors to be mounted on the door per the door manufacturer's requirements.
    - c. All trim to be thru-bolted to the lock stile case.
    - d. Lever trim to be solid case material with a break-away feature to limit damage to the unit from vandalism. Lever design to match locksets.
    - e. All exit devices to be made of brass, bronze, stainless steel, or aluminum material, powder coated, anodized, or plated to the standard architectural finishes to match the balance of the door hardware.
    - f. Provide glass bead conversion kits to shim exit devices on doors with raised glass beads.
    - g. All exit devices to be one manufacturer. No deviation will be considered.
    - h. All exit devices to be non-handed. Touchpad to extend a minimum of 1/2 of the door width and to extend to the height of the cross rail housing for a "no pinch" operation. Plastic touchpads are not acceptable. Plastic linkage and "dogging" components are not acceptable.
    - i. Surface vertical rod devices to be UL labeled for fire door applications without the use of bottom rod assemblies. Where bottom rods are required for security applications, the devices to be UL labeled for fire doors applications with rod and latch guards by the device manufacturer.
    - j. Exit devices to include impact resistant, flush mounted end cap design to avoid damage due to carts and other heavy objects passing through an opening. End cap to be of heavy-duty metal alloy construction and provide horizontal adjustment to provide alignment with device cover plate. When exit device end cap is installed, no raised edges will protrude.

- D. Electric Strikes:
1. Acceptable manufacturers:
    - a. Von Duprin\*
    - b. Rutherford
  2. Characteristics:
    - a. Heavy duty, stainless steel construction.
    - b. Adjustable strike box to compensate for any misalignment of door or frame.
    - c. Two-piece plug connectors for ease of installation and for removal during strike servicing.
- E. Closers and Door Control Devices:
1. Acceptable manufacturers:
    - a. Falcon SC71A /SC81A\*
    - b. LCN 4050 / 1450
  2. Characteristics:
    - a. Door closers to have fully hydraulic, full rack and pinion action with a high strength cast aluminum cylinder.
    - b. All closers to utilize a stable fluid withstanding temperature range of 120°F to -30°F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors to be provided with temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL 10C.
    - c. Spring power to be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation to be by tamper-proof, non-critical valves. Closers to have separate adjustment for latch speed, general speed and back check.
    - d. All closers to have solid forged steel main arms (and forearms for parallel arm closers) and where specified to have a cast-in solid stop on the closer shoe ("DS"). All parallel arm mounted closers to have "EDA" type arms or, where door travel on out-swing doors must be limited, use "DS" or "SS" type closers. Auxiliary stops are not required when "DS" type closers are used. Provide drop plates where top rail of door is not sufficient for closer mounting. Provide "cush shoe supports" and blade stop spacers where dictated by frame details.
    - e. Overhead concealed closers to have spring power adjustable for 50% increase in closing power and fully mortised door tracks.
    - f. All surface closers to be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory. All closers (overhead, surface and concealed) to be of one manufacturer.

- g. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped provide adjustable units complying with ADA and ANSI A-117.1 provisions for door opening force.
  - h. Closers to be installed to allow door swing as shown on plans. Doors swinging into exit corridors to provide for corridor clear width as required by code. Where possible, mount closers inside rooms.
  - i. Magnetic Door Holders to be heavy duty wall or floor mounted with metal housing and complete mounting hardware. Provide 24V holding coils unless otherwise scheduled.
- F. Overhead Door Holders:
- 1. Acceptable manufacturers:
    - a. Glynn Johnson\* 450
    - b. Rixson Firemark 9
  - 2. Characteristics:
    - a. Provide (heavy duty and/or medium duty and/or light duty) door holders (concealed and/or surface mounted) of brass, bronze or stainless steel.
    - b. Concealed holders to be installed with the jamb bracket mortised flush with the bottom of the jamb. The arm and channel to be mortised into the door.
    - c. Surface holders to be installed with the jamb bracket mounted on the stop.
- G. Floor Stops and Wall Bumpers:
- 1. Acceptable manufacturers:
    - a. Trimco
    - b. Ives\*
    - c. Rockwood Manufacturing
  - 2. Characteristics: Refer to Hardware Headings.
- H. Door Bolts/Coordinators:
- 1. Acceptable manufacturers:
    - a. Trimco
    - b. Ives\*
    - c. Rockwood Manufacturing
  - 2. Characteristics:
    - a. Flush bolts to be forged brass 6-3/4" x 1", with 1/2" diameter bolts. Plunger to be supplied with milled surface one side that fits into a matching guide.
    - b. Automatic flush bolts to be UL listed as top and bottom bolts on a pair of classified fire doors. Bolt construction to be of rugged steel and brass components.
    - c. Self-latching flush bolts to be UL listed as top and bottom bolts on a pair of classified fire doors. Bolt construction to be of rugged steel and brass components.
    - d. Automatic flush bolts and self-latching flush bolts to be UL listed for fire door application without bottom bolts (LBB).

- e. Furnish dust proof bottom strikes.
  - f. Coordinator to be soffit mounted non-handed fully automatic UL listed coordinating device for sequential closing of paired doors with or without astragals.
  - g. Provide filler piece to close the header. Provide brackets as required for mounting of soffit applied hardware.
- I. Push Plates:
- 1. Acceptable manufacturers:
    - a. Trimco
    - b. Ives\*
    - c. Rockwood Manufacturing
  - 2. Characteristics:
    - a. Exposed Fasteners: Provide manufacturers standard exposed fasteners.
    - b. Material to be wrought/extruded/forged, brass/ bronze /aluminum/stainless steel, per the Hardware Headings.
    - c. Provide plates sized as shown in Hardware Headings.
- J. Door Pulls & Pull Plates:
- 1. Acceptable manufacturers:
    - a. Trimco
    - b. Ives\*
    - c. Rockwood Manufacturing
  - 2. Characteristics:
    - a. Provide concealed thru-bolted trim on back to back mounted pulls, but not for single units.
    - b. Material to be extruded forged/ cast, brass/ bronze/ aluminum/ stainless steel.
    - c. Provide units sized as shown in Hardware Headings.
- K. Push Pull Sets:
- 1. Acceptable manufacturers:
    - a. Trimco
    - b. Ives\*
    - c. Rockwood Manufacturing
  - 2. Characteristics:
    - a. Provide mounting systems as shown in hardware sets.
    - b. Material to be (description - i.e. solid rod, tubular, cast etc.). Brass/bronze aluminum/stainless steel.
    - c. Provide Push/Pull sets sized as shown in Hardware Headings.

- L. Protective Plates:
1. Acceptable manufacturers:
    - a. Trimco
    - b. Ives\*
    - c. Rockwood Manufacturing
  2. Characteristics:
    - a. Provide manufacturers standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.
    - b. Materials:
      - 1) Metal Plates: Stainless Steel, .050 inch (U.S. 18 gage).
    - c. Fabricate protection plates not more than 2 inches less than door width on push side and not more than 1 inch less than door width on pull side.
    - d. Heights:
      - 1) Kick plates to be 8 inches in height.
      - 2) Mop plates to be 8 inches in height.
      - 3) Armor plates to be 36 inches in height. Armor plates on fire doors to comply with NFPA 80.
- M. Thresholds:
1. Acceptable manufacturers:
    - a. Zero Weatherstripping CO., Inc\*
    - b. Reese Industries
    - c. Pemko
  2. Types: Indicated in Hardware Headings.
- N. Door Seals/Gasketing:
1. Acceptable manufacturers:
    - a. Zero Weatherstripping Co., Inc.\*
    - b. Reese Industries
    - c. Pemko
  2. Types: Indicated in Hardware Headings.
    - a. Install door seals and weatherstripping with double coated 3M tape.
- O. Silencers:
1. Acceptable manufacturers:
    - a. Hager
    - b. Ives\*
    - c. Rockwood Manufacturing
  2. Three for each single door; two for each pair of doors.
- P. Key Cabinet and System:
1. Acceptable manufacturers:
    - a. Telkee, Inc.
    - b. Lund
    - c. MMF
    - d. Key Control Systems
  2. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent



markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the project.

- a. Provide complete cross index system set up by key control distributor, and place keys on markers and hooks in the cabinet as determined by the final key schedule.
- b. Provide hinged-panel type cabinet for wall mounting.
- c. Provide multiple-drawer type cabinet.

Q. Security Equipment:

1. Acceptable manufacturers:
  - a. Schlage\*
2. Characteristics:
  - a. Provide items as found in Hardware Headings.
3. Coordinate security equipment with electrical.

## 2.2 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
1. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
  2. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
  3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.
  4. Do not use thru-bolts or sex bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of adequately fastening the hardware, or otherwise found in Headings. Coordinate with wood doors and metal doors and frames. Where thru-bolts are used, provide sleeves for each thru-bolt as a means of reinforcing the work, or use sex screw fasteners.

**2.3 HARDWARE FINISHES**

- A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).
- B. Provide finishes that match those established by ANSI or, if none established, match the Architect's sample.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- D. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer."
- E. The designations used to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
  - 1. Hinges (Exterior): 630 (US32D) Satin Stainless Steel
  - 2. Hinges (Interior): 626/652 (US26D) Satin Chrome Plated Steel
  - 3. Manual Flush Bolts: 626 (US26D) Satin Chrome Plated Brass/Bronze
  - 4. Automatic and Self-latching Flush Bolts: 630 (US32D) Satin Stainless Steel
  - 5. Mortise Locks (Exterior): 630 (US32D) Satin Stainless Steel
  - 6. Mortise Locks (Interior): 626 (US26D) Satin Chrome Plated
  - 7. Exit Device: 626 (US26D) Satin Chrome Plated
  - 8. Door Closers: 689 (US28) Powder Coat Aluminum
  - 9. Push and Pull Plates: 630 (US32D) Satin Stainless Steel
  - 10. Door Pulls: 630 (US32D) Satin Stainless Steel
  - 11. Protective Plates: 630 (US32D) Satin Stainless Steel
  - 12. Floor Stops: 626 (US26D) Satin Chrome Plated Brass/Bronze
  - 13. Wall Stops: 626 (US26D) Satin Chrome Plated
  - 14. Overhead Stops and Holders: 630 (US32D) Satin Stainless Steel
  - 17. Thresholds/Weatherstripping: 627/628 (US27/US28) Aluminum

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
  - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
  - 2. "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames" by the Door and Hardware Institute.
  - 3. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

**3.2 ADJUSTING, CLEANING, AND DEMONSTRATING**

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
  - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to function properly with final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Door Hardware Supplier's Field Service:
  - 1. Inspect door hardware items for correct installation and adjustment after complete installation of door hardware.

2. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
3. File written report of this inspection to Architect.

3.3 HARDWARE SCHEDULE

HW SET: 01 - EXTERIOR EXIT WITH ACCESS CONTROL

DOOR NUMBER:

51                      56B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	REMOVABLE MULLION	4023 STAB	SP28	FAL
1	EA	ELEC PANIC HARDWARE	LD-RX-25-R-EO	626	FAL
1	EA	ELEC PANIC HARDWARE	RX-FSE-25-R-L-SUT 24 VDC	626	FAL
1	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	SURFACE CLOSER	SC81A SS	689	FAL
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	MULTITECH READER	MTB11 / MTB15 (BY SECURITY)	BLK	SCE
2	EA	DOOR CONTACT	679-05	WHT	SCE

COORDINATE WITH SECURITY, FIRE AND ELECTRICAL SYSTEMS. OPERATION: DOOR NORMALLY SECURED. PRESENTATION OF VALID CARD/FOB AT READER UNLOCKS LEVER TRIM AND SHUNTS DOOR POSITION SWITCH FOR AUTHORIZED ENTRY. RX SWITCH IN INSIDE LEVER SHUNTS DOOR POSITION SWITCH ON EXIT. FREE EGRESS AT ALL TIMES

HW SET: 10 - MEN & WOMENS RESTROOM

DOOR NUMBER:

29                    31

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	SC81A HW/PA	689	FAL
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER

HW SET: 11 - RESTRM CORDR

DOOR NUMBER:

032

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	PUSH PLATE	8200 4" X 16"	630	IVE
2	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
2	EA	SURFACE CLOSER	SC81A SSHO	689	FAL
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	630	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER
1	EA	ASTRAGAL	8042SBK PSA	BK	ZER

HW SET: 12 - CONF. RM.

DOOR NUMBER:

43A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	MA101 SG	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA	689	FAL
			PROVIDE MTG BRKT, SPCR & PLATE AS REQ		
1	EA	WALL STOP	WS406/407CCV	630	IVE

HW SET: 20 - ELEC. RM /IT ROOM/ STAFF AREA WITH ACCESS CONTROL WITH ACCESS CONTROL

DOOR NUMBER:

48                      49                      50

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	EU STOREROOM LOCK	MA881-24BDC SG 24VDC	626	FAL
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	SC81A RW/PA PROVIDE MTG BRKT, SPCR & PLATE AS REQ	689	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MTB11 / MTB15 (BY SECURITY)	BLK	SCE

COORDINATE WITH ELECTRICAL, FIRE AND SECURITY SYSTEMS

OPERATION: PRESENTATION OF VALID CARD AT READER SHUNTS DOOR CONTACT AND RELEASES ELECTRIC LOCKSET FOR AUTHORIZED ENTRY. FREE EGRESS AT ALL TIMES. FAIL SECURE

HW SET: 21 - BREAKRM WITH ACCESS CONTROL

DOOR NUMBER:

53

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	EU STOREROOM LOCK	MA881-24BDC SG 24VDC	626	FAL
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	SC81A RW/PA PROVIDE MTG BRKT, SPCR & PLATE AS REQ	689	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MTB11 / MTB15 (BY SECURITY)	BLK	SCE

COORDINATE WITH ELECTRICAL, FIRE AND SECURITY SYSTEMS

OPERATION: PRESENTATION OF VALID CARD AT READER SHUNTS DOOR CONTACT AND RELEASES ELECTRIC LOCKSET FOR AUTHORIZED ENTRY. FREE EGRESS AT ALL TIMES. FAIL SECURE

HW SET: 30 - STORAGE WITH ACCESS CONTROL

DOOR NUMBER:

52

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
5	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458 12"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	EU STOREROOM LOCK	MA881-24BDC SG 24VDC	626	FAL
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	SURFACE CLOSER	SC81A SS	689	FAL
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	630	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER
1	EA	ASTRAGAL	8042SBK PSA	BK	ZER
1	EA	MULTITECH READER	MTB11 / MTB15 (BY SECURITY)	BLK	SCE

COORDINATE WITH ELECTRICAL, FIRE AND SECURITY SYSTEMS

OPERATION: PRESENTATION OF VALID CARD AT READER SHUNTS DOOR CONTACT AND RELEASES ELECTRIC LOCKSET FOR AUTHORIZED ENTRY. FREE EGRESS AT ALL TIMES. FAIL SECURE

HW SET: 31 - SIMULATION WITH ACCESS CONTROL

DOOR NUMBER:

12

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
5	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	REMOVABLE MULLION	4023 STAB	SP28	FAL
1	EA	ELEC FIRE EXIT HARDWARE	RX-F-25-R-EO	626	FAL
1	EA	ELEC FIRE EXIT HARDWARE	RX-FSE-F-25-R-L-SUT 24 VDC	626	FAL
2	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
2	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	SURFACE CLOSER	SC81A SSHO	689	FAL
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS441	626	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	MULTITECH READER	MTB11 / MTB15 (BY SECURITY)	BLK	SCE

COORDINATE WITH SECURITY, FIRE AND ELECTRICAL SYSTEMS. OPERATION: DOOR NORMALLY SECURED. PRESENTATION OF VALID CARD/FOB AT READER UNLOCKS LEVER TRIM FOR AUTHORIZED ENTRY. FREE EGRESS AT ALL TIMES

HW SET: 40 - RESTROOM / WELLNESS WITH OCCUPY INDICATOR

DOOR NUMBER:

33                      34                      35                      51                      56

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	MA301 OCCUPIED/VACANT SGM	643e	FAL
1	EA	SURFACE CLOSER	SC81A HW/PA	689	FAL
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER



HW SET: 70 - THEATER / SIMULATION

DOOR NUMBER:

06A                    06A                    039                    53

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	25-R-L-SUT	626	FAL
1	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	SC81A SSHO	689	FAL
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER

HW SET: 71 - GATHERING LAWN

DOOR NUMBER:

56A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	REMOVABLE MULLION	4023 STAB	SP28	FAL
2	EA	PANIC HARDWARE	25-R-L-SUT	626	FAL
2	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
2	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	SURFACE CLOSER	SC81A SSHO	689	FAL
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS441	626	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

HW SET: 80 - JANITOR / STORAGE

DOOR NUMBER:

05                    36

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	MA581BDC SG	626	FAL
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	SC81A HW/PA	689	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
4	EA	SILENCER	SR64	GRY	IVE

HW SET: 81 - APS ELECTRICAL / APS SPACE

DOOR NUMBER:

57                    58

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	REMOVABLE MULLION	4023 STAB	SP28	FAL
1	EA	PANIC HARDWARE	25-R-EO	626	FAL
2	EA	PANIC HARDWARE	25-R-L-NL-SUT	626	FAL
2	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
2	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	SURFACE CLOSER	SC81A SS	689	FAL
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	630	IVE
1	EA	PERIMETER DOOR SEAL	488SBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

HW SET: 82 - STORAGE

DOOR NUMBER:

03

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	MA581BDC SG	626	FAL
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	SC81A DSHO	689	FAL
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 90 - CASED OPEN FRAME

DOOR NUMBER:

029

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
NO HARDWARE REQUIRED				

HW SET: AL-01 - EXTERIOR ENTRANCE WITH ACCESS CONTROL

DOOR NUMBER:

01A

EACH TO HAVE:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA POWER TRANSFER	EPT10	689	VON
1	EA REMOVABLE MULLION	4023 STAB	SP28	FAL
1	EA ELEC PANIC HARDWARE	RX-MEL-24-R-EO 24 VDC	626	FAL
1	EA ELEC PANIC HARDWARE	RX-MEL-24-R-NL-OP 24 VDC	626	FAL
1	EA SFIC RIM CYLINDER	80-159	626	SCH
1	EA PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA LONG DOOR PULL	9264F 30" O	630-316	IVE
2	EA SURFACE CLOSER	SC81A SS	689	FAL
1	EA MULLION SEAL	8780NBK PSA	BK	ZER
1	EA SEALS	BY DOOR MANUFACTURER		
2	EA DOOR SWEEP	BY DOOR MANUFACTURER		B/O
1	EA THRESHOLD	566A-223	A	ZER
2	EA DOOR CONTACT	679-05HM	BLK	SCE
1	EA POWER SUPPLY	PS902 900-2RS 120/240 VAC	LGR	SCE

COORDINATE WITH SECURITY AND ELECTRICAL SYSTEMS. PRESENT VALID CREDENTIALS TO READER SHUNTS POSITION SWITCH AND RELEASES ELECTRIC EXIT DEVICE FOR AUTHORIZED ENTRY. RX SWITCH INSIDE PUSHBAR SHUNTS DOOR POSITION SWITCH TO EXIT. FREE EGRESS AT ALL TIMES

HW SET: AL-02 - BOARDRM

DOOR NUMBER:

37

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458 12"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	DEADLATCH	4900 X 4560	628	ADA
1	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	LONG DOOR PULL	PR 9264F 30" P	630-316	IVE
2	EA	SURFACE CLOSER	SC81A DSHO	689	FAL
1	EA	SEALS	BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	BY DOOR MANUFACTURER		B/O

HW SET: AL-03 - INTERIOR VEST ENTRANCE / CONF. RM.

DOOR NUMBER:

01B                      41

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (8EA @ 01B)	652	IVE
2	EA	LONG DOOR PULL	PR 9264F 30" P	630-316	IVE
2	EA	SURFACE CLOSER	SC81A SS	689	FAL
1	EA	SEALS	BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	BY DOOR MANUFACTURER		B/O

HW SET: AL-04 - STAFF AREA WITH ACCESS CONTROL

DOOR NUMBER:

44A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	4023 STAB	SP28	FAL
1	EA	ELEC PANIC HARDWARE	RX-MEL-24-R-EO 24 VDC	626	FAL
1	EA	ELEC PANIC HARDWARE	RX-MEL-24-R-NL-OP 24 VDC	626	FAL
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	LONG DOOR PULL	9264F 30" O	630-316	IVE
2	EA	SURFACE CLOSER	SC81A RW/PA	689	FAL
			PROVIDE MTG BRKT, SPCR & PLATE AS REQ		
2	EA	FLOOR STOP	FS441	626	IVE
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	SEALS	BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	BY DOOR MANUFACTURER		B/O
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	LGR	SCE

COORDINATE WITH SECURITY AND ELECTRICAL SYSTEMS. PRESENT VALID CREDENTIALS TO READER SHUNTS POSITION SWITCH AND RELEASES ELECTRIC EXIT DEVICE FOR AUTHORIZED ENTRY. RX SWITCH INSIDE PUSHBAR SHUNTS DOOR POSITION SWITCH TO EXIT. FREE EGRESS AT ALL TIMES

HW SET: AL-05 - LOUNGE / BREAKRM

DOOR NUMBER:

45                      46

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	LONG DOOR PULL	PR 9264F 30" P	630-316	IVE
1	EA	SURFACE CLOSER	SC81A SS	689	FAL
1	EA	SEALS	BY DOOR MANUFACTURER		
1	EA	DOOR SWEEP	BY DOOR MANUFACTURER		B/O

HW SET: AL-06 - CLASSROOM

DOOR NUMBER:

40A                    40B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458 18"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	DEADLATCH	4900 X 4560	628	ADA
1	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
2	EA	LONG DOOR PULL	PR 9264F 30" P	630-316	IVE
2	EA	SURFACE CLOSER	SC81A HW/PA	689	FAL
2	EA	FLOOR STOP	FS441	626	IVE
1	EA	SEALS	BY DOOR MANUFACTURER		
1	EA	ASTRAGAL	BY ALUM DOOR MANUFACTURER		B/O

HW SET: AL-07 - CLASSROOM

DOOR NUMBER:

40C                    43B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DEADLATCH	4900 X 4560	628	ADA
1	EA	SFIC MORTISE CYL.	80-132 X K510-730 36-083 36-082-025	626	SCH
1	EA	PERMANENT IC CORE	AS REQUIRED	626	BES
1	EA	LONG DOOR PULL	PR 9264F 30" P	630-316	IVE
1	EA	SURFACE CLOSER	SC81A SS	689	FAL
1	EA	SEALS	BY DOOR MANUFACTURER		
1	EA	DOOR SWEEP	BY DOOR MANUFACTURER		B/O

END OF SECTION 087100



**SECTION 088000 - GLAZING**

1. Submittals: Product Data.
2. 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.  
GANA Publications: "Glazing Manual."
3. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II. Provide safety glazing for typical locations unless noted otherwise.  
Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label as acceptable to authorities having jurisdiction.
4. Glass Products: Annealed Float Glass: ASTM C 1036, Type I, Quality-Q3. Fully Tempered Float Glass: ASTM C 1048, Kind FT; Type I; Quality-Q3.
5. Glass Thicknesses: Minimum thicknesses as recommended by glass manufacturer for specific application.
6. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
7. Decorative Vinyl Film for Application to Glass: As indicated on Drawings.
8. Installation: Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are contained in GANA's "Glazing Manual." Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics. Remove nonpermanent labels, and clean surfaces immediately after installation. Follow direction of vinyl film manufacturer for application of decorative film to glass.

END OF SECTION 088000





**SECTION 088300 – MIRRORS**

1. Submittals: Product Data, and Shop Drawings.
2. Warranty: Manufacturer special 5 year warranty.
3. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass; SunGuard Mirror or a comparable product by one of the following: Binswanger Mirror; a division of Vitro America, Inc., Lenoir Mirror Company, National Glass Industries
4. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror-coating process.
5. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear. Nominal Thickness: 6.0 mm minimum.
6. Safety Glazing Products. Film-backed mirrors complying with testing requirements in 16 CFR 1201 for Category II materials.
7. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
8. Film Backing for Safety Mirrors. Film backing and pressure sensitive adhesive; both compatible with mirror-backing paint as certified by mirror manufacturer.
9. Aluminum J Channels: Clear, bright anodized aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of each mirror in a single piece. Manufacturer: C.R. Laurence Co., Inc., or equal as approved by Architect.
10. Mirror Mastic Primer: As recommended by mirror mastic manufacture for locations where primers are recommended or required by mirror mastic manufacturer for the mirror mounting substrate.
11. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed. Basis-of-Design Product: Subject to compliance with requirements, provide Laurence, C.R. Co., Inc; or a comparable product by one of the following: Palmer Products Corporation. Pecora Corporation. Adhesive shall have a VOC content of 70 or less.
12. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
13. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.
14. Fabrication: Mirror Edge Treatment: Rounded polished. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
15. Film-backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer.
16. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
17. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

18. Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
19. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
20. Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed so heads do not impose point loads on backs of mirrors. Top and Bottom Aluminum J Channels. Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points.
21. Install mastic as follows: Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8-inch (3 mm) between back of mirrors and mounting surface. Provide a minimum of 1/4-inch free clearance between edge of glass and adjacent surfaces, and edges of exposed glass at butt-joint mirror locations.
22. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 088300

**SECTION 090190 - MAINTENANCE REPAINTING**

1. Submittals: Product Data: Include printout of MPI's "MPI Approved Products List" with product highlighted. Samples of each paint type, color and sheen.
2. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.
3. Extra Materials: Deliver to Owner 1 gal. of each color and type of finish-coat paint used on Project, in containers, properly labeled and sealed.
4. Preconstruction Testing: Testing of cleaning materials, paint removers and compatibility of paint coatings and systems.
5. Preparatory Cleaning: [Detergent cleaning] [solvent cleaning] [cleaning with mildewcide] [chemical rust removal] [and] [mechanical rust removal].
6. Lightly sand surface. Ensure clean, dull and dry substrate.
7. Patching and Repairing: Hollow metal door substrates with dents and gouges larger than 1/8 inch.
8. Paint: Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: PPG Paints, Benjamin Moore & Co. Dulux (formerly ICI Paints), Duron, Inc., Sherwin-Williams Company (Basis-of-Design), Tnemec Paint. Provide additional transition coat where existing coating is not compatible with paint system specified. Do not paint over door rating labels.
9. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."
10. Refer to Division 09 Section 'Interior Painting' for additional information on application of paint.
11. Painting Schedule Notes: See Finish Schedule on Drawings for Gloss and Sheen of paint products. For locations not indicated on Finish Schedule, use gloss and sheens as indicated below. All sheens are subject to confirmation (Owner / Interior Designer approval) by paint mockup review. Number of coats indicated below are minimums.
12. Ferrous Metal Coating System for Existing Hollow Metal Doors and Frames:
  - a. Primer for pre-painted surfaces: SW; B51W01150 Extreme Bond Primer @ 2.0 – 4.0 mils DFT.
  - b. First Coat: SW; B53W02151 Pro-Industrial Waterbased Alkyd Urethane Semi-Gloss @ 2.0 – 2.5 mils DFT.
  - c. Topcoat: SW; B53W02151 Pro-Industrial Waterbased Alkyd Urethane Semi-Gloss @ 2.0 – 2.5 mils DFT.

END OF SECTION 090190



**SECTION 092600 – SIMULATED FINISHES FOR INTERIOR APPLICATIONS**

1. Section includes simulated interior finishes including simulated brick, wood, masonry, stucco, EIFS, and metallic finishes. Products are indicated on Finish Schedule as Stucco (STU-xx) Finishes.
2. Samples: Basic systems, textures and finishes shall match Interior Designer samples. Submit 2 samples of each simulated finish, approximately 2' x 2' in size for final color and finish approval. Architect will keep one sample, and return one sample for jobsite use.
3. Submittals: Product data and maintenance data.
4. Installer Qualifications: Minimum 5 years of documented experience with work of similar scope and complexity required by this Project.
5. Single Source Manufacturer of Simulated Interior Finish System Products. All product / material components shall be provided by, or as recommended in writing by Manufacturer.
6. Acceptable Manufacturers: Dryvit Systems, Finestone, Sto Corp. or subject to conformance with requirements, comparable products as approved by Architect.
7. Provide heavy duty, abuse resistant, and stain-resistant, materials typically from floor level up to 8'-0" minimum height.
8. Simulated interior finishes shall be applied over cementitious board substrates as specified in Division 09 Section "Gypsum Board".

END OF SECTION 092600



**SECTION 092713 - GLASS-FIBER-REINFORCED PLASTER FABRICATIONS**

1. Submittals: Product data, Shop Drawings and Samples.
2. Glass-Fiber Reinforced Plaster (GFRP) Fabrications: Molded, glass-fiber-reinforced gypsum units complying with ASTM C 1381/C 1381M.
3. Embedments: As standard with GFRP fabrication manufacturer and as required for reinforcement and for anchorage to substrates and framing.
4. Adhesives: As recommended by GFRP manufacturer.
5. Steel Drill Screws: Of sufficient length and size to securely fasten GFRP fabrications to framing members, and complying with ASTM C 1002 and ASTM C 954.
6. Joint-Treatment Materials: ASTM C 475/C 475M.
7. Fabricate GFRP units to comply with ASTM C 1381/C 1381M, with smooth-finished surfaces; repair surface imperfections. Fabricate units in sizes that will minimize number of joints between abutting units. Embedments: Incorporate embedments into units to develop the full strength of GFRP fabrications. Cover embedments with not less than 3/16-inch (5-mm) thickness of GFRP composite. Connection Hardware: Designed and fabricated to support and connect GFRP fabrications.
8. Installation: Comply with requirements in ASTM C 1467/C 1467M.
9. Acclimatize GFRP fabrications to ambient temperature and humidity of spaces in which they will be installed for not less than 48 hours before installing them.
10. Install GFRP fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.
11. Predrill fastener holes. Fasten as required to comply with dimensional tolerances and not less than 5/16 inch (7.9 mm) from edges or ends of units.
12. Attach pieces at joints with adhesive, and band or brace together until adhesive is cured.
13. Use joint-treatment materials to finish GFRP fabrications to produce surfaces ready to receive primers and paint finishes. Finish joints between units and countersunk fastener heads to comply with ASTM C 840 for Level 4 and to match surface texture of units.

END OF SECTION 092713





**SECTION 092900 - GYPSUM BOARD**

1. Submittals: Product Data.
2. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
3. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.
4. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Regular type unless otherwise indicated, Type X where indicated, Type as required for specific fire-resistance-rated assemblies, and Sag-resistant type for ceiling surfaces. Provide in maximum lengths available to minimize end-to-end butt joints. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: Georgia-Pacific Building Products. National Gypsum Company. PABCO Gypsum. United State Gypsum Company.
5. Water-Resistant Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated. Regular type unless otherwise indicated, Type X where required for fire-resistance-rated assemblies and where indicated.
6. Glass-Mat, Water-Resistant Gypsum Backing Board: ASTM C 1178/C 1178M, of thickness indicated. Regular type unless otherwise indicated, Type X where required for fire-resistance-rated assemblies and where indicated.
7. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, 1/2 inch thick, Type A, in maximum lengths available to minimize end-to-end butt joints. Acceptable products: United States Gypsum Company - Durock Brand Cement Board; Custom Building Products – Wonderboard; FinPan, Inc. - Util-A-Crete Concrete Backer Board; National Gypsum Company - PermaBase Cement Board.
8. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. Provide cornerbead at outside corners unless otherwise indicated. Provide LC-bead (J-bead) at exposed panel edges. Provide control joints where indicated.
9. Joint-Treatment Materials: ASTM C 475/C 475M. Joint Tape: Paper unless otherwise recommended by panel manufacturer. Joint Compounds: Setting-type compounds or Drying-type, ready-mixed, all-purpose compounds for interior locations. Tile Backer Unit Joint-Treatment Materials: Products recommended by cementitious backer unit manufacturer, with alkali-resistant fiber mesh tape (FibraTape or equal) and a latex modified Portland cement mortar.
10. Install gypsum board to comply with ASTM C 840. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.
11. Control Joints: Install control joints as per the following: At locations as indicated on Drawings. According to ASTM C 840. In specific locations approved by Interior designer for visual effect.

Per the following requirements: Ceilings: Space control joints not more than 50 feet o.c., and not more than 30 feet o.c. for ceilings without perimeter relief. Install control joints where ceiling framing or furring changes direction. Walls: Space control joints not more than 30 feet o.c. Install control joints in furred assemblies where control joints occur in base wall.

12. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.
13. Finishing Gypsum Board: ASTM C 840. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
14. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions and with alkali-resistant fiber mesh tape (FibraTape or equal) and a latex modified Portland cement mortar.

END OF SECTION 092900

**SECTION 093013 - CERAMIC TILING**

1. Submittals: Product Data and Samples.
2. Installer Qualifications: Engage an experienced Installer who has an experience history of successful completion of tile installations similar in material, design and extent indicated for Project, for a period of at least five years.
3. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
4. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA. installation methods specified in tile installation schedules, and other requirements specified.
5. Provide Ceramic tile that complies with ANSI A137.1. Ceramic Tile Type: porcelain tile.
6. Cementitious Backer Units: See Division 09 Section "Gypsum Board." Glass-Mat, Water-Resistant Gypsum Backing Board: See Division 09 Section "Gypsum Board."
7. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall have a VOC content of 65 g/L or less.
8. Fabric-Reinforced, Fluid-Applied Crack Isolation Membrane (for partial coverage use – see below): System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Bonsal American, an Oldcastle company. Custom Building Products; Basis of Design product for "Partial Coverage Crack Isolation Membranes" for use over cracks and control joints in concrete substrates – "CrackBuster Pro Crack Isolation Membrane"; or Laticrete International, Inc., or Mapei Corporation. Typical full field coverage application, unless noted otherwise, over tile substrates where a crack isolation membrane is specified: In compliance with ANSI A118.12 "standard performance, and in accordance with TCNA ceramic tile installation method F125-Full. Where full coverage applications are used, also reinforce cracks and control joints in concrete substrates per "Partial Coverage crack isolation membrane" requirements below.
9. Latex-Portland Cement Mortar (Medium bed for thinset applications): For locations of typical "oversize" ceramic tile (tile that is greater than 15 inches in length in any dimension) application, except as noted otherwise: ANSI A118.15. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Custom Building Products; Basis of Design product - "ProLite" Tile and Stone Mortar; or equal by Laticrete International, Inc., or Mapei Corporation. Provide prepackaged, dry-mortar mix to which only water must be added at Project site. For wall applications, provide non-sagging mortar. For floor applications, provide non-slumping mortar.
10. Latex-Portland Cement Mortar – Interior Standard Size Tile (Thinset): For standard size thinset tile locations except where noted otherwise, ANSI A118.4. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Custom Building Products; Basis of Design product - "VersaBond Flex" Tile and Stone Mortar; Laticrete International, Inc.; MAPEI Corporation. Provide prepackaged, dry-mortar mix to which only water must be added at Project site. For wall applications, provide non-sagging mortar.
11. Grout type coordination with tile Joint widths: Provide grout type as follows, per manufacturer's written recommendations for use with associated joint widths: Unsanded grout for joint widths

- up to 1/8-inch wide. Sanded grout for joint widths of 1/8-inch or larger. Or manufacturer approved special matrix grout for joint width applications of 1/16-inch to 1/2-inch wide.
12. High-Performance Latex-portland Cement Tile Grout: ANSI A118.7. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Custom Building Products; Basis of Design product – Prism SureColor Grout™; or equal by Laticrete International, Inc. or Mapei Corporation. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
  13. Water-Cleanable Epoxy Grout: ANSI A118.3. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Custom Building Products - Basis of Design product – “CEG Lite Epoxy Grout™”; Laticrete International, Inc.; MAPEI Corporation.
  14. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, are specified in tile installation schedules, and apply to types of setting and grouting materials used.
  15. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight, aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
  16. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.
  17. Install cementitious backer units and glass-mat, water-resistant gypsum backing board fiber-cement underlayment, and treat joints according to ANSI A108.11, according to manufacturer's written instructions, and with alkali-resistant fiber mesh tape (FibraTape or equal) and a latex-portland cement mortar.
  18. Ceramic Tile Installation for oversize tiles (greater than 15" in any dimension) at concrete slab on grade installations: TCNA F113; thinset mortar. See also crack suppression installation TCNA F125-12 (partial) for treatment of cracks and control joints in concrete substrates associated with this installation method. Ceramic Tile Type: As indicated on Finish Schedule. Thinset Mortar: Medium-bed, non-slumping, latex- portland cement mortar. Grout: High-performance (polymer modified) grout.
  19. Interior Wall Installations: Ceramic Tile Installation for “dry” wall locations: TCNA W248; thinset mortar on glass-mat moisture resistant gypsum backer units. Ceramic Tile Type: Glazed wall tile. Thinset Mortar: Latex-portland cement mortar. Grout: High-performance (polymer modified) grout.

END OF SECTION 093013

**SECTION 095113 - ACOUSTICAL PANEL CEILINGS**

1. Submittals: Product Data and Samples.
2. Acoustical Panels for Acoustical Panel Ceiling: Basis-of-Design Products are as listed on Drawings. Equivalent products of other manufacturer's will be accepted with approval of Interior designer. Clouds: 7/8-inch fiberglass circular shapes with finish on all surfaces. Pre-assembled panels with metal extrusions for installation from structure.
3. 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.
4. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
5. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements: Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
6. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
7. 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. 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. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
8. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
9. Install acoustical 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." Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
10. 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. Arrange directionally patterned acoustical units and clouds as indicated on Drawings.

END OF SECTION 095113



**SECTION 096513 - RESILIENT BASE AND ACCESSORIES**

1. Submittals: Product Data.
2. Extra Materials: Deliver to Owner at least 10 linear feet of each type and color of resilient wall base installed.
3. Thermoset Rubber Base: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous). Manufacturers: Subject to compliance with requirements, provide products by one of the following: Burke Mercer Flooring Products; Division of Burke Industries, Inc., Johnsonite, Musson, R. C. Rubber Co., Roppe Corporation, USA.
4. Style: As indicated on Drawings.
5. Minimum Thickness: 0.125 inch (3.2 mm).
6. Height: 4 inches (102 mm) unless indicated otherwise on Drawings.
7. Lengths: Coils in manufacturer's standard lengths.
8. Rubber Molding Accessories. Manufacturers: Subject to compliance with requirements, provide basis of design product as indicated on Drawings, or equal products by one of the following: Burke Mercer Flooring Products; Division of Burke Industries, Inc., Flexco, Inc., Johnsonite. Description: Reducer strip for resilient flooring, Joiner for tile and carpet and Transition strips.
9. Installation Accessories Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated. Low-Emitting Materials: Adhesives shall have a VOC content of 50 g/L or less.
10. Installation: Prepare horizontal surfaces according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Adhesively install resilient wall base and accessories. Install wall base in maximum lengths possible. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required. Install reducer strips at edges of floor coverings that would otherwise be exposed.

END OF SECTION 096513





**SECTION 096519 - RESILIENT TILE FLOORING**

1. Submittals: Product data and Samples.
2. Extra Materials: Deliver to Owner one box of each type and color of resilient floor tile installed.
3. Luxury Vinyl Tile: Manufacturer, product, and sizes as indicated on Drawings.
4. Rubber Floor Tile: Manufacturer, product, and sizes as indicated on Drawings.
5. Vinyl Composition Floor Tile: Manufacturer, product, and sizes as indicated on Drawings.
6. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement- or blended-hydraulic-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
7. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
8. Floor Polish: Protective liquid floor polish products as recommended by manufacturer.
9. Installation: Prepare concrete substrates according to ASTM F 710. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Lay out tiles so tile widths at opposite edges of room are equal and are at least one-half of a tile. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged. Lay tiles in patterns indicated.
10. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish. Apply coat(s) as recommended in writing by manufacturer.

END OF SECTION 096519



**SECTION 096813 - TILE CARPETING**

1. Submittals: Product Data and Samples.
2. Extra Materials: Deliver to Owner carpet tiles and textile composite tiles equal to 5 percent of each type and color installed, packaged with protective covering for storage.
3. Carpet products listed on the Drawings have been approved by Interior designer.
4. Textile Composite Flooring: Modular tiles comprised of combination of soft-surface floor covering with long-wearing performance characteristics of hard-surface flooring as scheduled on Drawings.
5. Products listed are to conform to manufacturer's printed specifications which are in effect as of this date. Colors for all carpet tiles and textile composite tiles are as listed, or as selected by Interior designer. All carpet tiles, textile composite tiles and necessary overruns are to be from one dye lot, but where multiple dye lots are required, submit samples from each dye lot to Interior designer for written approval before installing carpet tiles. Each dye lot to match approved sample.
6. Carpet and Textile Composite: Refer to Finish Schedule on Drawings for selections and installation locations.
7. Adhesive: Premium grade, water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions and expected service indicated, pressure-sensitive type that complies with flammability requirements for installed carpet tiles and textile composite flooring and is recommended or provided by manufacturers. Adhesive shall be release type, allowing removal of carpet tile and modular textile composite flooring without damage to material or substrate.
8. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation: Acceptable Products: Euclid, EUCO Polypatch, Mapei, PLANI/PATCH, Tamms, Floorstone with Latex Liquid.
9. Carpet Edge Strips: Burke Mercer Flooring Products, Imperial Reducer for glue-down installation; color selected by Interior designer from manufacturer's standard colors.
10. Installation: Comply with CRI 104.
11. Carpet Tile Installation Method: As recommended by manufacturer. Install borders parallel to walls.
12. Textile Composite Flooring Installation Method: As recommended by manufacturer.

END OF SECTION 096813



**SECTION 096814 - ARTIFICIAL GRASS SURFACING**

1. Section includes artificial grass surfacing.
2. Action Submittals: Product Data: For each type of product, include product data for pad recommended by artificial grass surfacing manufacturer. Samples: For each exposed product and for each color and texture specified.
3. Informational Submittals: Sample of special warranty.
4. Field Conditions: Comply with CRI 104 for temperature, humidity, and ventilation limitations.
5. Special Warranty for Artificial Grass Surfacing: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination. Warranty Period: 10 years from date of Substantial Completion.
6. Artificial Grass Surfacing: Manufacturers: Subject to compliance with requirements, provide Basis of Design product as indicated on Drawings. Other acceptable manufacturer: SYNLawN.
7. Installation Accessories: Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by manufacturer. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed artificial grass surfacing and is recommended or provided by manufacturers.
8. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting performance. Examine artificial grass surfacing for type, color, pattern, and potential defects. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710. Proceed with installation only after unsatisfactory conditions have been corrected. Preparation: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
9. Installation: Comply with CRI 104 and manufacturers' written installation instructions for the following: Direct-Glue-Down Installation: Comply with CRI 104, Section 9 "Direct Glue-Down Installation." as recommended by manufacturer
10. Comply with artificial grass surfacing manufacturer's written recommendations and Shop Drawings for seam locations and direction of artificial grass surfacing; maintain uniformity of artificial grass surfacing direction and lay of pile. At doorways, center seams under the door in closed position. Do not bridge building expansion joints with artificial grass surfacing. Cut and fit artificial grass surfacing to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by manufacturer. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with manufacturer's written recommendations.

END OF SECTION 096814



**SECTION 097200 - WALL COVERINGS**

1. Submittals: Product Data and Samples.
2. Extra Materials: Deliver to Owner full-width rolls of wall covering equal to 5 percent of amount of each type installed, packaged with protective covering for storage.
3. Surface-Burning Characteristics: Flame-spread and smoke-developed indexes of not more than 25 and 450, respectively, per ASTM E 84.
4. Vinyl Wall Covering: Manufactures and Products as Indicated on Drawings. Vinyl Wall covering Standard: CFFA-W-101-D; Type as indicated on Drawings. Stain-Resistant Coating: Manufacturer's standard product, as recommended in writing by manufacturer.
5. Specialty Wall Covering: As indicated on Drawings/Finish Schedule.
6. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall covering manufacturer. Low-Emitting Materials: Adhesives shall have a VOC content of 50 g/L or less.
7. Primer/Sealer: Mildew-resistant primer/sealer complying with Section 099123 "Interior Painting" and recommended in writing by wall covering manufacturer for intended substrate. Installation: Preparation: Clean substrates of substances that could impair wall covering's bond, including dirt, oil, grease, mold, mildew, and incompatible primers. Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter. Prime new gypsum board. Treat areas of painted surfaces susceptible to pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper. Acclimatize wall covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
9. Installation: Install seams vertical and plumb, with no horizontal seams. Match pattern 72 inches (1830 mm) above finish floor. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces using cleaning methods recommended by wall covering manufacturer. Replace strips that cannot be cleaned.

END OF SECTION 097200





**SECTION 099123 - INTERIOR PAINTING**

1. Submittals: Product Data: Include printout of MPI's "MPI Approved Products List" with product highlighted. Samples of each paint type, color and sheen.
2. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.
3. Extra Materials: Deliver to Owner [1 gal. (3.8 L)] of each color and type of finish-coat paint used on Project, in containers, properly labeled and sealed.
4. Paint: Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: PPG Paints (Basis-of-Design), Benjamin Moore & Co. Dulux (formerly ICI Paints), Duron, Inc., Sherwin-Williams Company, Tnemec Paint.
5. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."
6. Material Compatibility: Provide materials that are compatible with one another and with substrates. 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.
7. Paints and coatings shall comply with the following limits for VOC content: Flat Paints and Coatings: 50 g/L. Nonflat Paints, Coatings: 150 g/L. Primers, Sealers, and Undercoaters: 200 g/L. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L. Floor Coatings: 100 g/L.
8. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.
9. Paint exposed surfaces unless otherwise indicated. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only. Paint the back side of access panels. Color-code mechanical piping in accessible ceiling spaces. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.
10. Apply paints according to manufacturer's written instructions. Use brushes only where the use of other applicators is not practical. Use rollers for finish coat on interior walls and ceilings.
11. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
12. Painting Schedule Notes: See Finish Schedule on Drawings for Gloss and Sheen of paint products. For locations not indicated on Finish Schedule, use gloss and sheens as indicated below. All sheens are subject to confirmation (Owner / Interior Designer approval) by paint mockup review. Number of coats indicated below are minimums.
13. Ferrous Metal Coating System: Refer to Division 09 Section 'Maintenance Repainting' for painting of existing hollow metal doors and frames.
  - a. Surface Preparation for unpainted surfaces: Minimum surface preparation is Hand Tool or Power Tool Clean per SSPC-SP2 or SP3. Surface must be clean, dry and free from dirt,

loose paint, oil, grease, wax, rust, loose mill scale and any other contamination. Sand all slick or glossy surfaces to dull the existing finish. Remove all sanding dust and residual contamination. Any rusty areas or bare areas on the steel must be spot primed prior to coating. Follow all additional surface preparation guidelines on technical data sheets.

- b. Primer (Spot Primer) for pre-painted surfaces: PPG Paints; 90-908 Series Pitt-Tech® Plus Int./Ext. DTM Industrial Primer @ 2.0 – 4.0 mils DFT.
  - c. Primer Coat for unpainted surfaces that have not been factory primed per other specification sections: PPG Paints; 90-908 Series Pitt-Tech® Plus Int./Ext. DTM Industrial Primer @ 2.0 – 4.0 mils DFT.
  - d. First Coat: PPG Paints; 6-1510 Speedhide Interior/Exterior Waterborne Alkyd Semi-Gloss @ 1.4 – 1.6 mils DFT.
  - e. Topcoat: PPG Paints; 6-1510 Speedhide Interior/Exterior Waterborne Alkyd Semi-Gloss @ 1.4 – 1.6 mils DFT.
14. Gypsum Board Coating System:
- a. Surface Preparation: Surface must be clean, dry and free from dirt, loose paint, oil, grease, wax, chalk, efflorescence, mildew, dust, and any other contamination. Any damaged areas should be repaired prior to priming and painting. Follow all additional surface preparation guidelines on technical data sheets.
  - b. Primer for unpainted surfaces: PPG Paints; 6-4900XI Series SPEEDHIDE Zero Interior Zero-VOC Latex Sealer @ 1.2 mils DFT.
  - c. First Coat: PPG Paints; 6-4310XI Series SPEEDHIDE Zero Interior Zero-VOC Latex Eggshell @ 1.4 mils DFT for Eggshell sheen locations, and 6-4410XI Series SPEEDHIDE Zero Interior Zero-VOC Latex Satin @ 1.5 mils DFT for Satin sheen locations.
  - d. Topcoat: PPG Paints; 6-4310XI Series SPEEDHIDE Zero Interior Zero-VOC Latex Eggshell @ 1.4 mils DFT for Eggshell sheen locations, and 6-4410XI Series SPEEDHIDE Zero Interior Zero-VOC Latex Satin @ 1.5 mils DFT for Satin sheen locations.
15. Wood Coating System:
- a. Primer for unpainted surfaces: PPG Paints; 17-921 Series Seal Grip Interior Exterior Universal Acrylic Primer @ 1.6 mils DFT.
  - b. First Coat: PPG Paints; 6-1510 Speedhide Interior/Exterior Waterborne Alkyd Semi-Gloss @ 1.4 – 1.6 mils DFT.
  - c. Topcoat: PPG Paints; 6-1510 Speedhide Interior/Exterior Waterborne Alkyd Semi-Gloss @ 1.4 – 1.6 mils DFT.
16. Wood Staining System: Product as indicated on Finish Schedule. Apply finishes according to manufacturer's written instructions.
- a. Waterborne Clear Acrylic Over Stain System: Stain Coat: Interior wood stain (semitransparent). Three Finish Coats: Waterborne clear acrylic (satin) or (semigloss).
  - b. Waterborne Acrylic Clear Over Stain System: Three Finish Coats: Waterborne clear acrylic (satin) or (semigloss).

END OF SECTION 099123

**SECTION 099123 - INTUMESCENT PAINTING**

1. Submittals: Product Data: For each type of product including manufacturer's printed documentation that products/systems meet performance requirements. Include dry film thickness, number and thickness of coatings, system requirements and application instructions to meet performance requirements.
2. Performance requirements for wood items as indicated on Drawings. Surface-Burning Characteristics of Fire-Retardant Systems: As tested according to ASTM E84 or UL 723; testing by a qualified testing agency. Flame-Spread Index: 25 or less. Smoke-Developed Index: 50 or less.
3. Material Compatibility: Provide materials for use within each intumescent 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. For each material or coat, provide products recommended in writing by intumescent paint manufacturer for use on substrate indicated. Comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Albi Manufacturing; a division of StanChem, Inc., Flame Control Coatings, LLC., Flame Seal Products, Inc., Shield Industries.; "ForceField FireGuard E-84" (Basis-of-Design).
5. Examination: Comply with manufacturers printed instructions and requirements, and the following: Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for surface treatments, shop-primed surfaces, maximum moisture content, and other conditions affecting performance of the Work.
6. Begin coating only when moisture content of wood substrate is 15 percent or less when measured with an electronic moisture meter.
7. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides. Verify suitability of substrates, including surface conditions, and compatibility with existing finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
8. Preparation: Comply with manufacturer's printed instructions applicable to substrates and coating systems indicated. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if surface moisture content or alkalinity exceeds that permitted in manufacturer's written instructions. Remove incompatible primers, and reprime substrate with compatible primers as required to produce coating systems indicated. Perform cleaning and coating application so dust and other contaminants from cleaning process do not fall on wet, newly coated surfaces.
9. Installation: Apply intumescent paints according to manufacturer's written instructions and to comply with requirements for surface-burning characteristics specified. Use equipment and techniques best suited for substrate and type of material being applied. Coat surfaces behind movable items the same as similar exposed surfaces. Apply each coat separately according to manufacturer's written instructions.
10. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

11. Cleaning and Protection: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.
12. Schedule:
- a. Fire-Retardant, Water-Based System:
    - i. Prime Coat: When required by Basis-of-Design intumescent paint manufacturer, provide as recommended in writing by intumescent paint system manufacturer.
    - ii. Intumescent Coat: Basis-of-Design Product: Shield Industries; "ForceField FireGuard E-84" @ 15 mils DFT minimum, and in thickness as required to meet performance requirements.
      - 1. Color: White.
    - iii. Sealer: If required by intumescent paint Basis-of-Design manufacturer, provide per manufacturer's printed recommendations.
    - iv. Topcoat: As recommended by intumescent paint Basis-of-Design manufacturer, provide per manufacturer's printed recommendations.
  - b.

END OF SECTION 099646

**SECTION 102119 – PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS**

1. Submittals: Product Data, Shop Drawings, and Samples.
2. Performance Requirements: Flame-Spread Index: 25 or less. Smoke-Developed Index: 450 or less. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Accurate Partitions Corp.; ASI Group, American Sanitary Partition Corporation, Bobrick Washroom Equipment, Inc., Bradley Corporation, Global Partitions; ASI Group, Metpar Corp., or equal, subject to conformance with requirements and approval of Interior designer.
4. Toilet-Enclosure Style: Floor mounted and overhead braced.
5. Urinal-Screen Style: Wall hung.
6. Door, Panel, and Pilaster Construction: Plastic-laminate facing sheets pressure laminated to particleboard core without splices or joints in facings or cores; with laminate applied to edges before faces. Seal exposed core material at cutouts to protect core from moisture. Plastic Laminate: NEMA LD 3, Grade HGS. Core Material for Plastic Laminate: ANSI A208.1, Grade M-2 particleboard, in thicknesses required to provide nominal thicknesses of 1 inch (25 mm) minimum for doors, panels, and screens and 1-1/4 inches (32 mm) minimum for pilasters.
7. Pilaster Shoes: Manufacturer's standard design; stainless steel.
8. Brackets: Stirrup Type: Clear-anodized aluminum, Stainless steel or Chrome-plated brass. Full-Height (Continuous) Type (for urinal locations): Extruded aluminum or Stainless steel.
9. Doors: Unless otherwise indicated, 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.
10. Door Hardware: Clear-anodized aluminum, Stainless steel, or Chrome-plated brass. Hinges: Self-closing type. Latches and Keepers: Surface-mounted unit designed for emergency access and with combination rubber-faced door strike and keeper. Coat Hook: Combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories. Door Bumper: Rubber-tipped bumpers at out-swinging doors or entrance screen doors. Door Pull: Provide at out-swinging doors. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.
11. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use rust-resistant materials compatible with related materials.
12. Installation: Install units rigid, straight, level, and plumb, with not more than 1/2 inch (13 mm) between pilasters and panels and not more than 1 inch (25 mm) between panels and walls. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

END OF SECTION 102119



**SECTION 102800 – TOILET AND BATH ACCESSORIES**

1. Submittals: Product data, maintenance data.
2. Toilet Accessories: Provide toilet room accessories as indicated in schedules on Drawings.
3. Materials:
  - a. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
  - b. Sheet Steel: ASTM A 1008/A 1008M, 0.036-inch (0.9-mm) minimum nominal thickness.
  - c. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
  - d. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
  - e. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
  - f. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
  - g. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
  - h. Keys: Provide universal keys for internal access to accessories for servicing and resupplying as coordinated with Owner's existing keying system. Provide minimum of six keys to Owner's representative.
4. Installation: Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446. Adjust accessories for unencumbered, smooth operation, and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 102800





**SECTION 104400 – FIRE PROTECTION SPECIALTIES**

1. Submittals: Product Data.
2. Fire-Protection Cabinets: Enameled-steel, recessed cabinets for public locations and surface-mounted at back-of-house (non-public) cabinets; for fire extinguisher.
3. Fire-Protection Cabinets – Recessed: Basis-of-Design Product: Subject to compliance with requirements, provide Potter Roemer LLC; 7000 Alta Series, Model 7020-F VR or a comparable product by one of the following: JL Industries, Inc.; a division of the Activar Construction Products Group or Larsens Manufacturing Company.
4. Fire-Protection Cabinets – Surface Mounted: Basis-of-Design Product: Subject to compliance with requirements, provide Potter Roemer LLC; Alta Series, Model 7024-F VR or a comparable product by one of the following: JL Industries, Inc.; a division of the Activar Construction Products Group, or Larsens Manufacturing Company.
5. Cabinet Construction: Nonrated at typical locations.
6. Portable Fire Extinguishers: NFPA 10, listed and labeled for the type, rating, and classification of extinguisher.
7. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Roemer LLC; Product indicated below, or a comparable product by one of the following: JL Industries, Inc.; a division of the Activar Construction Products Group, or Larsens Manufacturing Company.  
Typical Locations and Inside Fire Extinguisher Cabinets: Potter-Roemer, Inc., Model 3010, 10 lb. ABC Multipurpose Dry-Chemical Type extinguisher; red enamel steel; complete with pressure gauge and mounting bracket. Electronic Equipment Rooms: Potter-Roemer, Inc., Model 3410, 10 lb. BC Carbon Dioxide Type fire extinguisher; red glossy polyester coated aluminum; complete with discharge horn, pressure gauge and wall mounting bracket.
8. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for fire extinguishers indicated, with plated or baked-enamel finish.
9. Install cabinets at 54 inches (1372 mm) above finished floor to top of cabinet heights unless indicated otherwise on Drawings, and as acceptable to authorities having jurisdiction.
10. Identification: Apply vinyl lettering to cabinets at locations indicated.
11. Install mounting brackets in locations indicated at 54 inches (1372 mm) above finished floor to top of fire extinguisher, and as acceptable to authorities having jurisdiction.
12. Install fire extinguishers in mounting brackets and cabinets where indicated.

END OF SECTION 104400



**SECTION 113100 - RESIDENTIAL APPLIANCES**

1. Submittals: Product Data, Maintenance Data.
2. Regulatory Requirements: Comply with the following:
  - a. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's Accessibility Guidelines and ICC A117.1.
4. Basis-of-Design Products: See Residential Appliances Fixture Schedule on drawings for specified appliances. The design for each residential appliance is based on the product named.
5. Accessories: Provide manufacturer's built-in installation kits for wall or cabinet mounting, complete with trim.
6. Installation: Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
7. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
8. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

END OF SECTION 113100



**SECTION 123661 - SIMULATED STONE COUNTERTOPS**

1. Submittals: Product Data, Shop Drawings, and material Samples.
2. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1. Basis-of-Design Product: Subject to compliance with requirements, products indicated on Drawings.
3. Install countertops according to manufacturer's written directions. Fasten to substrates with adhesive. Align adjacent surfaces. Seal seams and perimeter with mildew-resistant silicone sealant. Seal edges of cutouts in particleboard subtops by saturating with varnish.
4. Install level and plumb to a tolerance of 1/8 inch in 8 feet (3.2 mm in 2.4 m).

END OF SECTION 123661



**SECTION 124813 - ENTRANCE FLOOR MATS**

1. Submittals: Product Data and Samples.
2. Carpet-Type Mats: Manufacturer, product and size as indicated on Drawings.
3. Install surface-type units as indicated.

END OF SECTION 124813





**SECTION 210000 - GENERAL FIRE SUPPRESSION PROVISIONS**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

## 1.2 SUMMARY

- A. This Section includes general provisions covering the contract documents for Fire Protection Systems.

## 1.3 DEFINITIONS

- A. Provide shall mean "Furnish, install and connect."
- B. Piping shall mean "pipe installed with all specified fittings, valves and accessories, and forming a complete system."

## 1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Model numbers listed on the Mechanical Contract Documents shall not be construed to indicate electrical characteristics.
- C. Review of Submittals does not relieve the Contractor of any of the requirements of the Contract Documents. Failure by the Engineer to document errors and omissions in the Contractor's submittals during the Engineer's submittal review does not constitute a waiver of any of the requirements of the original Contract Documents.

## 1.5 CONTRACTOR QUALIFICATIONS

- A. Fire Protection System installer qualifications shall be specified in other sections of Division 21.

## 1.6 PRIOR APPROVALS

- A. Manufacturers References: When reference is made in the Contract Documents to trade names or specific manufacturers and/or models, such reference, unless noted otherwise, is made to designate and identify the quality of materials or equipment to be furnished and is not intended to restrict competitive bidding. If it is desired to use materials or equipment different from those indicated on the Contract Documents, written request for approval must reach the hands

of the Design Professional at least TEN DAYS prior to the date set for the opening of bids. A copy of the request should also be sent directly to the Engineer. Requests for prior approval of a proposed substitute shall be accompanied by complete technical data supporting the request.

- B. Request for Prior Approval by facsimile transmission (fax) or email will not be considered. Prior approval requests shall be submitted in hard copy format only.

#### 1.7 LAYOUT AND COORDINATION

##### A. Layout Basis:

1. The equipment listed on the Drawings and in the Specifications has been used for the physical arrangement of the mechanical systems. When equipment listed as acceptable, equal or equipment which has received "prior approval" is used, it shall be the Contractor's responsibility to provide structural, electrical, service clearances, or other changes required to accommodate the substituted equipment. Changes shall be made at no additional cost to the Owner. Submit a list of required changes along with all prior approval requests and shop drawing submittals.
2. The Contract Drawings are intended to show the general arrangement of all mechanical work. They do not show in detail all offsets, fittings and transitions. Examine Drawings, investigate site conditions to be encountered and arrange work accordingly. Furnish all offsets and transitions required.
3. Drawings do not indicate in detail exact configuration of connections for fixtures, equipment and accessories. Final connection shall be as shown on approved Manufacturer's Submittal Drawings. Where Manufacturer's Submittal Drawings conflict with the Contract Documents, confer with the Design Professional for resolution.
4. Measurement of Drawings by scale shall not be used as dimensions for fabrication. Measurements for locating fixtures, equipment, ductwork, piping and other mechanical items shall be made on the site and shall be based on actual job conditions.
5. Check space limitations and verify electrical requirements before ordering any mechanical equipment or materials. Place large equipment inside the building prior to the erection of exterior walls where equipment cannot enter finished building openings.

- B. Coordination: Mechanical work shall be coordinated with that of other trades to avoid conflict. The Contractor shall study all plans and specifications for this project and shall notify the Design Professional of any conflict between work under Division 21 and work under other divisions of the Project. Particular attention shall be given to interference between piping, electrical installations, structural systems, building openings and ductwork.

- C. Installation Instructions: Two binders containing manufacturer's installation instructions for all equipment furnished under Division 21 shall be furnished by the Contractor. One binder shall be kept in the General Contractor's office at the job site. The other binder shall be delivered to the Engineer upon acceptance by the Design Professional of the Submittals.

- D. Operation and Maintenance Instructions: Three copies of equipment O&M manuals contained in rigid 3-ring binders shall be submitted to the Owner a minimum of 15 days prior to equipment/systems training. Binders shall have permanent labels on the spine and front cover indicating project name, project number, building name and contents. Model and serial numbers of equipment shall be shown on the cover of their respective O&M manual(s).

**1.8 PERMITS**

- A. Obtain all necessary Permits and Inspections required for the installation of this work and pay all charges incident thereto. Deliver to the Design Professional all certificates of inspection issued by authorities having jurisdiction.
- B. all other charges for work under Division 21, including charges for meter installation and excess service by the utilities shall be paid by the Contractor.

**1.9 SAFETY**

- A. OSHA Requirements applicable to the project shall be complied with at all times.
- B. Manufacturer's Safety Instructions shall be followed in all instances.
- C. Asbestos Containing Materials (ACM) shall not be used on this project.
- D. Electrical Equipment Clearances: Piping, equipment and other mechanical installations shall not be located within 42" of the front or 36" of the side of any electrical switchboards, panelboards, power panels, motor control centers, electrical transformers or similar electrical equipment. Piping and ductwork shall not pass through or above electrical equipment rooms except as required to serve those rooms.

**1.10 PROTECTION OF FIRE SUPPRESSION SYSTEMS DURING CONSTRUCTION**

- A. Material storage:
  - 1. All materials and equipment stored on the jobsite shall be elevated above the ground and stored under suitable weather cover. Materials and equipment shall not be situated in areas subjected to localized flooding.
  - 2. Manufacturer's original shipping packaging and protective coverings shall be left in place until the equipment is prepared for installation.
- B. Electrical enclosure protection:
  - 1. During construction, all protective covers and other devices shall be left in place that protect against inadvertent contact with live electrical circuits.
  - 2. All warning labels related to electrical and rotating equipment hazards shall be in place prior to energizing mechanical equipment circuits.
- C. Protection of Equipment and piping:
  - 1. Maintain temporary closures on the ends of all equipment and pipes as the installation work progresses. Temporary closures include plastic sheeting, tape and appropriate caps and covers.
  - 2. Where debris enters piping during installation, steps shall be taken to clean the interior of the pipe prior to placing in service.
  - 3. Where debris enters equipment during installation the equipment interior shall be cleaned prior to placing in service.

1.11 CODES AND STANDARDS

- A. Mechanical installations shall conform to the current edition (recognized by the State) of the following, in addition to any previously mentioned Codes and Standards.
  - 1. The International Building Code.
  - 2. The International Mechanical Code.
  - 3. The International Plumbing Code.
  - 4. The International Fire Protection Code.
  - 5. NFPA Standard 13, Installation of Sprinkler Systems.
  - 6. NFPA Standard 70, National Electric Code.
  - 7. NFPA Standard 101, Code for Safety to Life for Fire in Buildings and Structures.

1.12 ASBESTOS MATERIALS

- A. Contractor is advised there may be **ASBESTOS PRODUCTS** in building(s) which will affect work under this Project. Particular reference is made to piping, equipment and other items that may be modified or removed. It shall be the sole responsibility of Contractor to check for and ascertain presence of asbestos materials where such presence affects work under this Project. Where Contractor ascertains presence of asbestos materials, he shall notify Owner and Engineer in writing of presence of asbestos **BEFORE** beginning any work. Removal of asbestos products shall be the responsibility of Owner **AFTER** he has been notified by Contractor of its presence.
- B. Engineer assumes no responsibility of investigating for presence of **ASBESTOS PRODUCTS** or for verifying presence of asbestos materials, nor does Engineer assume any responsibility for specifying, advising on, or supervising removal of any asbestos products. Contractor and Owner shall hold harmless Engineer in any matters involving presence of, or removal of, asbestos products.

1.13 INTERRUPTION OF EXISTING SERVICES

- A. Exercise care so as not to cut any existing utilities or services. Where an existing utility line or service line is cut it shall be repaired to "like-new" condition. Interruption of service shall not be made without prior written permission of the Owner.
- B. Fire suppression system must remain in service during construction. Arrange with the Owner well in advance of shutdowns required for tie-ins. Shutdowns shall be made after normal occupancy hours if so directed by the Owner. No additional monies will be paid for after-hours shutdowns.

PART 2 - PRODUCTS                      Not required for this section.

PART 3 - EXECUTION                    Not required for this section.

**END OF SECTION 210000**

**SECTION 210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following basic mechanical materials and methods to complement other Division 21 Sections.
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Equipment nameplate data requirements.
  - 3. Field-fabricated metal equipment supports.
  - 4. Installation requirements common to equipment specification Sections.
  - 5. Mechanical demolition.
  - 6. Cutting and patching.
  - 7. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in piping system Sections.

**1.3 DEFINITIONS**

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

**1.4 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for following piping specialties:
  - 1. Identification materials and devices.

- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

**1.5 QUALITY ASSURANCE**

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."
- B. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- C. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.

**1.7 SEQUENCING AND SCHEDULING**

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

**PART 2 - PRODUCTS****2.1 PIPE AND PIPE FITTINGS**

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

**2.2 JOINING MATERIALS**

- A. Refer to individual piping system specification Sections in Division 21 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch minimum thickness, except where thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
  - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
  - 3. AWWA C110, rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.



- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
- F. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.
  - 1. Sleeve: ASTM A 126, Class B, gray iron.
  - 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
  - 3. Gaskets: Rubber.
  - 4. Bolts and Nuts: AWWA C111.
  - 5. Finish: Enamel paint.

### 2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
  - 1. Inside Diameter: Closely fit around pipe, tube, and insulation.
  - 2. Outside Diameter: Completely cover opening.
  - 3. Cast Brass: One-piece, with set-screw.
    - a. Finish: Rough brass.
    - b. Finish: Polished chrome plate.
  - 4. Cast Brass: Split casting, with concealed hinge and set-screw.
    - a. Finish: Rough brass.
    - b. Finish: Polished chrome plate.
  - 5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
  - 6. Stamped Steel: One-piece, with spring clips and chrome-plated finish.
  - 7. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
  - 8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
  - 9. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome-plated finish.
  - 10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
  - 11. Cast-Iron Floor Plate: One-piece casting.
- B. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
  - 1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
  - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
  - 3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.

4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
  - a. Penetrating Pipe Deflection: 5 percent without leakage.
  - b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
  - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
  - d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.

#### 2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 21 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.
  1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
  2. Location: An accessible and visible location.
- C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.
- D. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine sub-core, except when other colors are indicated.
  1. Fabricate in sizes required for message.
  2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
  3. Punch for mechanical fastening.
  4. Thickness: 1/16 inch, except as otherwise indicated.
  5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

#### 2.5 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide UL Listed firestopping system for filling openings around penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

- B. Products: Subject to compliance with requirements, provide products by one of the following:
1. Specified Technologies, Inc.
  2. 3M Corporation
  3. Metacaulk.
  4. Hilti, Inc.

**PART 3 - EXECUTION****3.1 PIPING SYSTEMS--COMMON REQUIREMENTS**

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 21 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, suspended ceilings, cabinet interiors and other exposed locations, according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
  2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
  3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
  4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
  5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.
- N. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, exterior walls and where indicated.
1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
  2. Build sleeves into new walls and slabs as work progresses.
  3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than 6 inches.
    - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
    - c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."
      - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
  4. Seal annular space between sleeve and pipe or pipe insulation in non-rated floors and partitions, using elastomeric joint sealants. EXCEPTION: Fire rated partition penetrations shall be sealed with U.L. Listed firestopping systems.
- O. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with U.L. Listed firestopping sealant system.
- P. Verify final equipment locations for roughing in.
- Q. Refer to equipment specifications in other Sections for roughing-in requirements.
- R. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
  - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
  - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
  - c. Align threads at point of assembly.
  - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
  - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
4. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
5. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

### 3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Design Professional.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

### 3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  1. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.

2. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:
  - a. Near each valve and control device.
  - b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
  - c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
  - d. At access doors, manholes, and similar access points that permit view of concealed piping.
  - e. Near major equipment items and other points of origination and termination.
  - f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
  - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Valves: Provide hydraulic information on each remote at riser valve on permanently engraved metal signs.
- C. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

### 3.4 PAINTING AND FINISHING

- A. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Paint all exposed steel surfaces of piping and supports with one coat of primer and two coats of enamel.

### 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

### 3.6 DEMOLITION

- A. Disconnect, demolish, and remove work specified under Division 21 and as indicated.
- B. Where pipe, equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety. Cap existing piping and ductwork that remains in place.

- D. Abandoned Work: Cut and remove pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap piping and patch surface to match existing finish.
- E. Removal: Remove indicated equipment, piping and ductwork from the Project site unless noted otherwise.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- G. Remove all hangers, supports and anchors associated with mechanical items be removed. Patch surfaces to match adjacent finishes.

**3.8 CUTTING AND PATCHING**

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

**END OF SECTION 210500**

**SECTION 210519 - GAGES FOR FIRE PROTECTION PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes gages used in fire protection systems.

**1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of gage and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- C. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

**1.4 QUALITY ASSURANCE**

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.
- B. Design Criteria: The Drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated. Meters and gages having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Design Professional. The burden of proof for equality of meters and gages is on the proposer.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

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



1. Pressure Gages:
  - a. AMETEK, U.S. Gauge Div.
  - b. Ashcroft by Dresser Industries, Instrument Div.
  - c. Marsh Instrument Co.
  - d. Marshalltown Instruments, Inc.
  - e. H.O. Trerice Co.
  - f. Weiss Instruments, Inc.
  - g. Weksler Instruments Corp.
  - h. WIKA Instruments Corp.

## 2.2 PRESSURE GAGES

- A. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch -diameter glass lens.
- C. Connector: Brass, 1/4-inch.
- D. Scale: White-coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.
- F. Range: Conform to the following:
  1. Fluids Under Pressure: 2 times operating pressure.

## 2.3 PRESSURE-GAGE ACCESSORIES

- A. Snubbers: 1/4-inch brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

## PART 3 - EXECUTION

### 3.1 GAGE APPLICATIONS

- A. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.

### 3.2 GAGE INSTALLATION, GENERAL

- A. Install gages and accessories according to manufacturers' written instructions for applications where used.

**3.3 PRESSURE GAGE INSTALLATION**

- A. Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position. Install in locations indicated on the drawings.
- B. Install in the following locations and elsewhere as indicated:
  - 1. At suction and discharge of each pump.
  - 2. At building water service entrance.
  - 3. At floor control valves.
- C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon instead of snubber for steam pressure gages.

**3.4 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 21 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Install gages adjacent to machines and equipment to allow servicing and maintenance.

**3.5 ADJUSTING AND CLEANING**

- A. Adjusting: Adjust faces of gages to proper angle for best visibility.
- B. Cleaning: Clean windows of gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

**END OF SECTION 210519**

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**SECTION 210523 – GENERAL DUTY VALVES FOR FIRE PROTECTION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes general duty valves common to several mechanical piping systems.

**1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

**1.4 QUALITY ASSURANCE**

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. ASME B31.9 for building services piping valves.
  - 4. AWWA C606 for grooved end connections.
- B. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- C. Bronze and brass valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless the alloy is heat treated.
- D. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
  - 4. Block check valves in either closed or open position.

**PART 2 - PRODUCTS****2.1 BASIC, COMMON FEATURES**

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated. All valves shall be a full port design.
- C. Valve Actuator Types:
  - 1. Hand lever: For quarter-turn valves smaller than NPS 4 (DN 100).
- D. Threads: ASME B1.20.1.
- E. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- F. Grooved End Couplings: Valves with grooved ends may be used in grooved piping applications.

**2.2 BALL VALVES**

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Apollo Flow Controls; Conbraco Industries, Inc.
    - c. Hammond Valve.
    - d. Jomar Valve.
    - e. Legend Valve & Fitting, Inc.
    - f. NIBCO INC.

2. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: 600 psig (4140 kPa).
  - c. Body Design: Two piece.
  - d. Body Material: Heat treated forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel.
  - i. Port: Full.

### 2.3 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. American Valve, Inc.
  2. Apollo Flow Controls; Conbraco Industries, Inc.
  3. Crane; Crane Energy Flow Solutions.
  4. Hammond Valve.
  5. Jomar Valve.
  6. Legend Valve & Fitting, Inc.
  7. Milwaukee Valve Company.
  8. NIBCO INC.
- B. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- C. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.
- D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
  - 1. Swing Check Valves: Horizontal position with hinge pin level.
  - 2. Lift Check Valve: With stem upright and plumb.

### 3.3 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

**3.4 FLANGED CONNECTIONS**

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

**3.5 ADJUSTING**

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

**END OF SECTION 220523**



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**SECTION 210529**  
**HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawing and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes hangers and supports for fire suppression piping and equipment.

**1.3 DEFINITIONS**

- A. Terminology used in this Section is defined in MSS SP-90.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design seismic restraint hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

**1.5 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

**1.6 QUALITY ASSURANCE**

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
  1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
- E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
  1. Components include galvanized coatings or alternate rust preventing shop coating.
  2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

### 2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.

- D. Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic.
  - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Water: Potable.
  - 4. Packaging: Premixed and factory-packaged.

### PART 3 - EXECUTION

#### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

#### 3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- K. Support all piping direct from structure and independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stress from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
  - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
  - 3. Shields: Install MSS Type 40, protective shields on insulated piping. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

<u>NPS (Inches)</u>	<u>LENGTH (Inches)</u>	<u>THICKNESS (Inches)</u>
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

- 4. Pipes 6 Inches and Larger: Include shield inserts.
- 5. Insert Material: Length at least as long as the protective shield.
- 6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

**3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

**3.4 METAL FABRICATION**

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedure(s) for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

**3.5 ADJUSTING**

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

**3.6 PAINTING**

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- C. Paint all exposed steel surfaces with one coat of primer and two coats of enamel.

**END OF SECTION 210529**

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**SECTION 210560 - FIRE-SUPPRESSION PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes fire-suppression piping and equipment for the following building systems:
  - 1. Wet-pipe, fire-suppression sprinklers, including piping, valves, specialties, and automatic sprinklers.

**1.3 DEFINITIONS**

- A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 for obtaining approval from authorities having jurisdiction.
- B. Q.R.: Quick response.

**1.4 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Design sprinklers and obtain approval from authorities having jurisdiction.
- B. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
  - 1. Include 10 psi margin of safety for available water pressure.
  - 2. Include losses through water-service piping, valves, and backflow preventers.
  - 3. Sprinkler Occupancy Hazard Classifications: As follows:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 2.
    - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - e. Office and Public Areas: Light Hazard.
  - 4. Minimum Density for Automatic-Sprinkler Piping Design: As follows:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area. Area may be reduced as permitted by NFPA 13.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500- sq. ft. area. Area may be reduced as permitted by NFPA 13.



- c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500- sq. ft area. Area may be reduced as permitted by NFPA 13.
  - d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- C. Components and Installation: Capable of producing piping systems with 175-psig (1200-kPa) minimum working-pressure rating, unless otherwise indicated.

### 1.5 SUBMITTALS

- A. Product Data: For the following:
- 1. Pipe and fitting materials and methods of joining for sprinkler piping.
  - 2. Pipe hangers and supports.
  - 3. Valves, including specialty valves, accessories, and devices.
  - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
- B. Fire-Hydrant Flow Test Report: As specified in "Preparation" Article.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations, if applicable.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping".
- E. Maintenance Data: For each type of sprinkler specialty to include in maintenance manual.

### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.
- B. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.
- C. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
- 1. NFPA 13, "Installation of Sprinkler Systems."

**1.7 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Sprinkler, Drain and Alarm Test Fittings:
    - a. AGF Manufacturing
    - b. Globe Fire Sprinkler Corp.
    - c. Reliable
    - d. Smith-Cooper International; FPPI Div.
    - e. Viking Corp.
  2. Sprinkler, Inspector's Test Fittings:
    - a. AGF Manufacturing
    - b. Globe Fire Sprinkler Corp.
    - c. Reliable
    - d. Smith-Cooper International; FPPI Div.
    - e. Viking Corp.
  3. Electrically Operated Alarm Bell:
    - a. Fire Lite Alarms, Inc.; a Honeywell company
    - b. Notifier, a Honeywell company
    - c. Potter Electric Signal Company
  4. Sprinklers:
    - a. Globe Fire Sprinkler Corp.
    - b. Reliable Automatic Sprinkler Co., Inc.
    - c. Viking Corp.
    - d. Tyco

5. Indicator Valves:
  - a. Anvil International
  - b. Kennedy Valve Div.
  - c. Mueller
  - d. Nibco, Inc.
  - e. Stockham Valves & Fittings, Inc.
  - f. Victaulic Co. of America
  
6. Fire-Protection-Service Valves:
  - a. Anvil International
  - b. Grinnell.
  - c. Mueller
  - d. Nibco, Inc.
  - e. Stockham Valves & Fittings, Inc.
  - f. Victaulic Co. of America
  
7. Keyed Couplings for Steel Piping:
  - a. Anvil International
  - b. Grinnell
  - c. Gruvlok
  - d. Star Pipe Products, Inc.
  - e. Victaulic Co. of America.
  
8. Automatic Air Venting Device:
  - a. AGF Manufacturing
  - b. Globe Fire Sprinkler Corp.
  - c. Potter Signal
  - d. Reliable
  - e. Viking Corp

## 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

## 2.3 PIPES AND TUBES

- A. Standard-Weight Steel Pipe: ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 2 (DN150) and smaller.
- B. Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 2-1/2 and larger.
- C. Stainless Steel Tubing: UL listed, one-piece flexible tubing system. System assembly shall include couplings and ceiling grid mounting hardware; piping assembly shall be designed for connecting branch piping to sprinklers and mounting sprinklers in ceiling.

**2.4 PIPE AND TUBE FITTINGS**

- A. Cast-Iron Threaded Flanges: ASME B16.1.
- B. Cast-Iron Threaded Fittings: ASME B16.4.
- C. Malleable-Iron Threaded Fittings: ASME B16.3.
- D. Steel, Threaded Couplings: ASTM A 865.
- E. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.
- F. Steel Flanges and Flanged Fittings: ASME B16.5.
- G. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47 (ASTM A 47M), malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

**2.5 JOINING MATERIALS**

- A. Refer to other Division 21 sections for pipe-flange gasket materials and welding filler metals.
- B. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.
- C. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

**2.6 GENERAL-DUTY VALVES**

- A. Refer to other Division 21 sections for gate, ball, butterfly, globe, and check valves not required to be UL listed and FM approved.

**2.7 FIRE-PROTECTION-SERVICE VALVES**

- A. General: UL Listed and FM approved, with minimum 175-psig non-shock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.
- B. Gate Valves, NPS 2 and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.
  - 1. Indicator: Electrical, prewired, supervisory switch. Coordinate requirements with fire alarm system.

- C. Indicating Valves, NPS 2-1/2 and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.
  - 1. Indicator: Electrical, prewired, supervisory switch. Coordinate requirements with fire alarm system.
- D. Gate Valves, NPS 2-1/2 and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.
  - 1. Indicator: Electrical, prewired, supervisory switch. Coordinate requirements with fire alarm system.

## 2.8 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element complying with UL199.
- B. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Intermediate" temperature classification rating, unless otherwise indicated or required by application.
- C. Sprinkler types, features, and options include the following:
  - 1. Concealed ceiling sprinklers, including cover plate.
  - 2. Upright sprinklers.
- D. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  - 1. Ceiling Mounting: Steel, white finish, one piece, flat.
- E. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

## 2.9 SPECIALTY SPRINKLER FITTINGS

- A. Specialty Fittings: UL Listed and FM approved; made of steel, ductile iron, or other materials compatible with piping.
- B. Mechanical-T Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.
- C. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.
- D. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

- 2.10 SPRINKLER INSPECTOR'S TEST FITTINGS WITH INTEGRAL PRESSURE RELIEF AND DRAIN
- A. Standard: UL or FM Global, listing. NFPA 13.
  - B. Pressure Rating: 300 psig.
  - C. Body Material: Bronze body, brass stem, steel handle, chrome-plated bronze ball, virgin teflon valve seat.
  - D. Sight Glass: Bronze housing with viewing window.
  - E. Components: A tamper resistant test orifice and a tapped port for system access.
  - F. Pressure Relief Valve and Drainage Piping:
    - 1. Body Material: Bronze body and stainless-steel spring.
    - 2. Components: Nylobraid flexible tube, One 1/2 inch NPT by barbed 90 degree elbow, one 1/2" NPT by barbed straight adapter, external identification plate and integral flushing handle to remove debris
    - 3. 1/2-inch MIPT inlet, 1/2 inch FIPT outlet.
    - 4. Relief pressure shall be factory set to project specifications.
    - 5. Relief valve shall operate to the OPEN position between 90% and 105% of the set pressure.
    - 6. Relief valve shall reseal or CLOSE at a minimum of 80% of set pressure.
  - G. Size: F.I.P.T., same as connected piping.
  - H. Inlet and Outlet: Threaded.
- 2.11 ALARM DEVICES
- A. General: Types matching piping and equipment connections.
  - B. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  - C. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
- 2.12 PRESSURE GAGES
- A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch diameter dial with dial range of 0 to 250 psig.

**2.13 AIR VENTING DEVICE**

- A. Product: Device which automatically vents air from wet pipe sprinkler system..
  - 1. Standard: UL or FM Global, listing. NFPA 13.
  - 2. Pressure Rating: 300 psig, 175 psi for air vent.
  - 3. Body Material: Forged brass body.
  - 4. Components: Ball valve, stainless steel strainer, purge valve with hose connection, thread cap with lanyard, automatic air vent.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.
- B. Report test results promptly and in writing.

**3.2 EXAMINATION**

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 PIPING APPLICATIONS**

- A. Do not use welded joints with galvanized steel pipe.
- B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- C. Wet-Pipe Sprinklers: Use the following:
  - 1. NPS 2 and Smaller: Standard-weight steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.
  - 2. NPS 1-1/4 and larger: Schedule 10 steel pipe with roll-grooved ends; steel, grooved-end fittings; and grooved joints.
  - 3. NPS 1-1/4 and larger: Schedule 10 steel pipe with plain ends, steel welding fittings, and welded joints.

**3.4 VALVE APPLICATIONS**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Fire-Protection-Service Valves: UL Listed and FM approved for applications where required by NFPA 13.
    - a. Shutoff Duty: Use gate valves.
  - 2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13.
    - a. Shutoff Duty: Use gate, ball, or butterfly valves.
    - b. Throttling Duty: Use globe, ball, or butterfly valves.

**3.5 JOINT CONSTRUCTION**

- A. Refer to other Division 21 sections for basic piping joint construction.
- B. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.
- C. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to other Division 21 sections for dielectric fittings.

**3.6 WATER-SUPPLY CONNECTION**

- A. Connect sprinkler piping to existing sprinkler supply piping.

**3.7 PIPING INSTALLATION**

- A. Refer to other Division 21 sections for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with the Design Professional before deviating from approved working plans.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.



- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install pressure relief valves. Route pressure relief valve outlet to system drain piping.
- I. Install alarm devices in piping systems.
- J. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.
- K. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.
- L. Install flexible stainless-steel tubing systems in accordance with the manufacturer's instructions.
- M. Install automatic air venting device at high point of wet pipe sprinkler systems.

### 3.8 SPECIALTY SPRINKLER FITTING INSTALLATION

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

### 3.9 VALVE INSTALLATION

- A. Refer to other Division 21 sections for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and authorities having jurisdiction.
- B. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

### 3.10 SPRINKLER APPLICATIONS

- A. General: Use sprinklers according to the following applications:
  - 1. Rooms with Suspended Ceilings: Q.R. concealed sprinklers.
  - 2. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
  - 3. Sprinkler Finishes: Use sprinklers with the following finishes:

- a. Upright Sprinklers: Rough bronze in unfinished spaces not exposed to view.
- b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

**3.11 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

**3.12 CONNECTIONS**

- A. Connect water supplies to sprinklers.
- B. Connect piping to specialty valves, specialties, and accessories.
- C. Electrical Connections: Power wiring is specified in Division 26.
- D. Connect alarm devices to fire alarm.

**3.13 LABELING AND IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in other Division 21 sections.

**3.14 FIELD QUALITY CONTROL**

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to the Design Professional and authorities having jurisdiction.

**3.15 CLEANING**

- A. Clean dirt and debris from sprinklers. Where adhesive materials such as paint and drywall mud have adhered to sprinklers, they shall be replaced entirely.
- B. Remove and replace sprinklers having paint other than factory finish.

**3.16 PROTECTION**

- A. Protect sprinklers from damage until Material Completion.

**3.17 COMMISSIONING**

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete.
- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Fill wet-pipe sprinkler piping with water.
- F. Verify that hose connections are correct type and size.
- G. Energize circuits to electrical equipment and devices.
- H. Start and run air compressors.
- I. Adjust operating controls and pressure settings.
- J. Coordinate with fire alarm tests. Operate as required.

**3.18 DEMONSTRATION**

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. Schedule demonstration with Owner with at least seven days' advance notice.

**END OF SECTION 210560**

**SECTION 220000 - GENERAL PLUMBING PROVISIONS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes general provisions covering the contract documents for Plumbing Systems.

**1.3 DEFINITIONS**

- A. Provide shall mean "Furnish, install and connect."
- B. Piping shall mean "pipe installed with all specified fittings, valves and accessories, and forming a complete system."

**1.4 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Electrical Coordination: In addition to submittal requirements of other Division 22 Sections, submit a document approved by the project Electrical Contractor certifying that all mechanical equipment being furnished under Division 22 complies with the electrical characteristics of the source power which will be furnished under Divisions 26 and 27.
- C. Model numbers listed on the Mechanical Contract Documents shall not be construed to indicate electrical characteristics. Electrical characteristics of mechanical equipment shall be as indicated on the Electrical Contract Documents (Division 26).
- D. Review of Submittals does not relieve the Contractor of any of the requirements of the Contract Documents. Failure by the Engineer to document errors and omissions in the Contractor's submittals during the Engineer's submittal review does not constitute a waiver of any of the requirements of the original sealed Contract Documents.

**1.5 CONTRACTOR QUALIFICATIONS**

- A. Plumbing Subcontractor shall have a Class II Unlimited License and shall have demonstrated proficiency in the installation of plumbing systems by the successful installation of systems similar to those included in the Construction Documents for this project. Such systems shall have been installed in commercial or institutional buildings having a minimum of 150 plumbing

fixtures (in a single building). The Subcontractor shall have been in business as described above for a minimum period of five years.

- B. A master or journeyman plumber shall be present at the site during the installation of all plumbing related work. The master or journeyman plumber shall be certified in the state in which the construction is being performed and shall have his license present at site or on file during construction.
- C. Medical Gas System installer qualifications shall be specified in other sections of Division 22.

#### 1.6 PRIOR APPROVALS

- A. **Manufacturers References:** When reference is made in the Contract Documents to trade names or specific manufacturers and/or models, such reference, unless noted otherwise, is made to designate and identify the quality of materials or equipment to be furnished and is not intended to restrict competitive bidding. If it is desired to use materials or equipment different from those indicated on the Contract Documents, written request for approval must reach the hands of the Primary Design Professional at least TEN DAYS prior to the date set for the opening of bids. A copy of the request should also be sent directly to the Engineer. Requests for prior approval of a proposed substitute shall be accompanied by complete technical data supporting the request.

#### 1.7 LAYOUT AND COORDINATION

- A. **Layout Basis:**
  - 1. The equipment listed on the Drawings and in the Specifications has been used for the physical arrangement of the mechanical systems. When equipment listed as acceptable, equal or equipment which has received "prior approval" is used, it shall be the Contractor's responsibility to provide structural, ductwork, electrical, service clearances, or other changes required to accommodate the substituted equipment. Changes shall be made at no additional cost to the Owner. Submit a list of required changes along with all prior approval requests and shop drawing submittals.
  - 2. The Contract Drawings are intended to show the general arrangement of all mechanical work. They do not show in detail all offsets, fittings and transitions. Examine Drawings, investigate site conditions to be encountered and arrange work accordingly. Furnish all offsets and transitions required.
  - 3. Drawings do not indicate in detail exact configuration of connections for fixtures, equipment and accessories. Final connection shall be as shown on approved Manufacturer's Submittal Drawings. Where Manufacturer's Submittal Drawings conflict with the Contract Documents, confer with the Design Professional for resolution.
  - 4. Measurement of Drawings by scale shall not be used as dimensions for fabrication. Measurements for locating fixtures, equipment, ductwork, piping and other mechanical items shall be made on the site and shall be based on actual job conditions.
  - 5. Check space limitations and verify electrical requirements before ordering any mechanical equipment or materials. Place large equipment inside the building prior to the erection of exterior walls where equipment cannot enter finished building openings.

- B. Coordination: Mechanical work shall be coordinated with that of other trades to avoid conflict. The Contractor shall study all plans and specifications for this project and shall notify the Design Professional of any conflict between work under Division 22 and work under other divisions of the Project. Particular attention shall be given to interference between piping, electrical installations, structural systems, building openings and ductwork.
- C. Installation Instructions: Manufacturer's installation instructions for all equipment furnished under Division 22 shall be furnished by the Contractor. Instructions shall be maintained on the jobsite until the project is complete, and then turned over to the Owner.
- D. Operation and Maintenance Instructions: Electronic copies of equipment O&M manuals shall be submitted to the Owner a minimum of 15 days prior to equipment/systems training. An index document indicating project name, project number, building name and contents shall be included. Model and serial numbers of equipment shall be shown on the cover of their respective O&M manual(s). Warranty registration documentation shall be included where applicable, including documentation confirming warranties have been registered with the equipment manufacturer.

#### 1.8 PERMITS

- A. Obtain all necessary Permits and Inspections required for the installation of this work and pay all charges incident thereto. Deliver to the Design Professional all certificates of inspection issued by authorities having jurisdiction.

#### 1.9 SAFETY

- A. OSHA Requirements applicable to the project shall be complied with at all times.
- B. Manufacturer's Safety Instructions shall be followed in all instances.
- C. Asbestos Containing Materials (ACM) shall not be used on this project.
- D. Refrigerants containing CFC's or HCFC's shall not be used on this project, nor shall any equipment using such refrigerants be incorporated into this project.
- E. Electrical Equipment Clearances: Piping, equipment and other mechanical installations shall not be located within 42" of the front or 36" of the side of any electrical switchboards, panelboards, power panels, motor control centers, electrical transformers or similar electrical equipment. Piping and ductwork shall not pass through or above electrical equipment rooms except as required to serve those rooms.

#### 1.10 PROTECTION OF PLUMBING SYSTEMS DURING CONSTRUCTION:

- A. Material storage
  - 1. All materials and equipment stored on the jobsite shall be elevated above the ground and stored under suitable weather cover. Materials and equipment shall not be situated in areas subjected to localized flooding.

2. Manufacturer's original shipping packaging and protective coverings shall be left in place until the equipment is prepared for installation.
- B. Roof protection: All penetrations through roofs, including roof vents and roof drainage system elements shall be properly protected during construction to prevent water intrusion into the building. Protective measures could include temporary covers and plugs, as well as other appropriate temporary elements.
- C. Electrical enclosure protection
1. During construction, all protective covers and other devices shall be left in place that protect against inadvertent contact with live electrical circuits.
  2. All warning labels related to electrical and rotating equipment hazards shall be in place prior to energizing mechanical equipment circuits.
- D. Protection of equipment and piping
1. Maintain temporary closures on the ends of all equipment and pipes as the installation work progresses. Temporary closures include plastic sheeting, tape and appropriate caps and covers.
  2. Where debris enters piping during installation, steps shall be taken to clean the interior of the pipe prior to placing in service.
  3. Where debris enters equipment during installation the duct interior shall be cleaned prior to placing in service.

#### 1.11 CODES AND STANDARDS

- A. Mechanical installations shall conform to the current edition (recognized by the State) of the following, in addition to any previously mentioned Codes and Standards.
1. The International Building Code.
  2. The International Mechanical Code.
  3. The International Plumbing Code.
  4. The International Fire Protection Code.
  5. The State Energy Code.
  6. NFPA Standard 70, National Electric Code.
  7. NFPA Standard 101, Code for Safety to Life for Fire in Buildings and Structures.

#### 1.12 ASBESTOS MATERIALS

- A. Contractor is advised there may be ASBESTOS PRODUCTS in building(s) which will affect work under this Project. Particular reference is made to piping, equipment and other items that may be modified or removed. It shall be the sole responsibility of Contractor to check for and ascertain presence of asbestos materials where such presence affects work under this Project. Where Contractor ascertains presence of asbestos materials, he shall notify Owner and Engineer in writing of presence of asbestos BEFORE beginning any work. Removal of asbestos products shall be the responsibility of Owner AFTER he has been notified by Contractor of its presence.

- B. Engineer assumes no responsibility of investigating for presence of ASBESTOS PRODUCTS or for verifying presence of asbestos materials, nor does Engineer assume any responsibility for specifying, advising on, or supervising removal of any asbestos products. Contractor and Owner shall hold harmless Engineer in any matters involving presence of, or removal of, asbestos products.

**1.13 INTERRUPTION OF EXISTING SERVICES**

- A. Exercise care so as not to cut any existing utilities or services. Where an existing utility line or service line is cut it shall be repaired to "like-new" condition. Interruption of service shall not be made without prior written permission of the Owner.
- B. Plumbing system must remain in service during construction. Arrange with the Owner well in advance of shutdowns required for tie-ins. Shutdowns shall be made after normal occupancy hours if so directed by the Owner. No additional monies will be paid for after-hours shutdowns.

PART 2 - PRODUCTS                      Not required for this section.

PART 3 - EXECUTION                      Not required for this section.

**END OF SECTION 220000**



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**SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following basic mechanical materials and methods to complement other Division 22 sections.
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Concrete equipment base construction requirements.
  - 3. Equipment nameplate data requirements.
  - 4. Labeling and identifying mechanical systems and equipment is specified in Division 22.
  - 5. Field-fabricated metal and wood equipment supports.
  - 6. Installation requirements common to equipment specification Sections.
  - 7. Mechanical demolition.
  - 8. Cutting and patching.
  - 9. Touchup painting and finishing.

- B. Pipe and pipe fitting materials are specified in piping system Sections.

**1.3 DEFINITIONS**

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

**1.4 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.

- B. Product data for following piping specialties:
  - 1. Identification materials and devices.
- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

**1.5 QUALITY ASSURANCE**

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- E. Coordinate all electrical service requirements for mechanical equipment prior to the submittal of shop drawings. Confirm the compatibility of all power services with the equipment being furnished. Confirm compatibility of electrical lugs being provided by the equipment manufacturer with the power wiring being furnished under Division 26. Furnish written documentation that all characteristics have been coordinated with and confirmed by the electrical subcontractor.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

#### 2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 22 for special joining materials not listed below.

- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch minimum thickness, except where thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
  2. ASME B16.20 for grooved, ring-joint, steel flanges.
  3. AWWA C110, rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
- D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
- E. Solder Filler Metal: ASTM B 32.
1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
- F. Brazing Filler Metals: AWS A5.8.
1. BCuP Series: Copper-phosphorus alloys.
  2. BAgl: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvents complying with the following:
1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
  2. Chlorinated Poly (Vinyl Chloride) (CPVC): ASTM F 493.
  3. Poly (Vinyl Chloride) (PVC): ASTM D 2564.
  4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
- K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.
1. Sleeve: ASTM A 126, Class B, gray iron.
  2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.

3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

### 2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
1. Inside Diameter: Closely fit around pipe, tube, and insulation.
  2. Outside Diameter: Completely cover opening.
  3. Cast Brass: One-piece, with set-screw.
    - a. Finish: Polished chrome plate.
  4. Cast Brass: Split casting, with concealed hinge and set-screw.
    - a. Finish: Polished chrome plate.
  5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
  6. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
  7. Stamped Steel: Split plate, with exposed-rievet hinge, set-screw, and chrome-plated finish.
  8. Cast-Iron Floor Plate: One-piece casting.
- B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
  2. Insulating Material: Suitable for system fluid, pressure, and temperature.
  3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
  4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
  5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
  7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.
- C. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
  2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.

3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
  - a. Penetrating Pipe Deflection: 5 percent without leakage.
  - b. Housing: Ductile-iron casting having water-stop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
  - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
  - d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.

D. Piping Roof Curbs:

1. Curb and cap shall be constructed of minimum 18-gauge galvanized sheet metal with continuous welded seams.
2. Provide cant-strip at the base of curb for flashing.
3. Line curb with 1½-inch fiberglass insulation.
4. Galvanized sheet metal cap shall have welded sheet metal collars (sleeves) for each pipe that allow for installation of insulated pipe.
5. Seal annular space between pipe/insulation and collar with a flexible weatherproof boot and stainless-steel pipe clamps.
6. Cap shall be secured to the curb nailer with cadmium plated screws; minimum one per side.

## 2.4 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide UL Listed firestopping system for filling openings around penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
  1. Specified Technologies, Inc.
  2. 3M Corporation
  3. Metacaulk.
  4. Hilti, Inc.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 22 specify piping installation requirements unique to the piping system.

- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, suspended ceilings, cabinet interiors and other exposed locations, according to the following:
  - 1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
  - 2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
  - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
  - 4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge and chrome-plated finish.
  - 5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw clips.
- N. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, exterior walls and where indicated.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.



2. Build sleeves into new walls and slabs as work progresses.
3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
  - a. Steel Pipe Sleeves: For pipes smaller than 6 inches.
  - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
  - c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
    - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
4. Seal annular space between sleeve and pipe or pipe insulation in non-rated floors and partitions, using elastomeric joint sealants. EXCEPTION: Fire rated partition penetrations shall be sealed with U.L. Listed firestopping systems.
- O. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with U.L. Listed firestopping sealant system.
- P. Verify final equipment locations for roughing in.
- Q. Refer to equipment specifications in other Sections for roughing-in requirements.
- R. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
  1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
  4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
  5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
    - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
    - c. Align threads at point of assembly.
    - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.

7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
  8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
    - a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
    - b. Poly (Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
- S. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
  2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
  3. Install dielectric unions and flanges to connect piping materials of dissimilar metals.

### 3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Design Professional.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

### 3.3 PAINTING AND FINISHING

- A. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Paint all exposed steel surfaces of piping and supports with one coat of primer and two coats of enamel.

**3.4 CONCRETE BASES**

- A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete with 6 x 6 x #10 reinforcing wire mesh. Outdoor concrete bases shall extend a minimum of 4" above grade and be a minimum thickness of 6".

**3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

**3.6 DEMOLITION**

- A. Disconnect, demolish, and remove work specified under Division 22 sections and as indicated.
- B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety. Cap existing piping and ductwork that remains in place.
- D. Abandoned Work: Cut and remove pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap piping and patch surface to match existing finish.
- E. Removal: Remove indicated equipment, piping and ductwork from the Project site unless noted otherwise
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- G. Remove all hangers, supports and anchors associated with mechanical items be removed. Patch surfaces to match adjacent finishes.

**3.7 CUTTING AND PATCHING**

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

**END OF SECTION 220500**

**SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes meters and gages used in mechanical systems.

**1.3 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- C. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

**1.4 QUALITY ASSURANCE**

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.
- B. Design Criteria: The Drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated. Meters and gages having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Design Professional. The burden of proof for equality of meters and gages is on the proposer.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

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

1. Liquid-in-Glass Thermometers:
  - a. Marsh Instrument Co.
  - b. Marshalltown Instruments, Inc.
  - c. H.O. Terrice Co.
  - d. Weiss Instruments, Inc.
  - e. Weksler Instruments Corp.
  
2. Pressure Gages:
  - a. AMETEK, U.S. Gauge Div.
  - b. Ashcroft by Dresser Industries, Instrument Div.
  - c. Marsh Instrument Co.
  - d. Marshalltown Instruments, Inc.
  - e. H.O. Terrice Co.
  - f. Weiss Instruments, Inc.
  - g. Weksler Instruments Corp.
  - h. WIKA Instruments Corp.

## 2.2 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed as follows:
  1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
  
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

## 2.3 LIQUID-IN-GLASS THERMOMETERS

- A. Description: ASTM E 1, liquid-in-glass thermometer.
  
- B. Case: Die-cast aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
  
- C. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
  
- D. Tube: Red-reading, organic liquid-filled with magnifying lens.
  
- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
  
- F. Stem: Copper-plated, steel, aluminum, or brass for a separable socket of length to suit installation.

**2.4 THERMOMETER WELLS**

- A. Description: Brass or stainless-steel thermometer well.
- B. Pressure Rating: Not less than piping system design pressure.
- C. Stem Length: To extend to center of pipe.
- D. Extension for Insulated Piping: 2 inches nominal, but not less than thickness of insulation.
- E. Threaded Cap Nut: With chain permanently fastened to well and cap.

**2.5 PRESSURE GAGES**

- A. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch -diameter glass lens.
- C. Connector: Brass, 1/4-inch.
- D. Scale: White-coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.
- F. Range: Conform to the following:
  - 1. Fluids Under Pressure: 2 times operating pressure.

**2.6 PRESSURE-GAGE ACCESSORIES**

- A. Snubbers: 1/4-inch brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
- B. Pressure Gage and Thermometer Ranges: Approximately 2 times systems operating conditions.

**PART 3 - EXECUTION****3.1 METER AND GAGE APPLICATIONS**

- A. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.

**3.2 METER AND GAGE INSTALLATION, GENERAL**

- A. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

**3.3 THERMOMETER INSTALLATION**

- A. Install thermometers and adjust vertical and tilted positions. Install in the locations indicated on the drawings.
- B. Install in the following locations and elsewhere as indicated:
  - 1. At inlet and outlet of each water heater.
- C. Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.
  - 1. Install wells with stem extending to center of pipe.
  - 2. Fill wells with oil or graphite and secure caps.

**3.4 PRESSURE GAGE INSTALLATION**

- A. Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position. Install in locations indicated on the drawings.
- B. Install as indicated:
- C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon instead of snubber for steam pressure gages.

**3.5 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.

**3.6 ADJUSTING AND CLEANING**

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

- C. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

**END OF SECTION 220519**



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**SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes general duty valves common to several mechanical piping systems.

**1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

**1.4 QUALITY ASSURANCE**

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. Valve solder-joint connections are common in smaller sizes of plumbing piping. Soldering and brazing methods used to achieve required pressure-temperature ratings may damage internal valve parts. Special installation requirements for soldered valves may make threaded valves more cost-effective.
  - 4. Caution: Use solder with melting point below 421 deg F (216 deg C).
  - 5. ASME B16.18 for solder-joint connections.
  - 6. ASME B16.51 for press-fit connections.
  - 7. ASME B31.9 for building services piping valves.
- B. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- C. Bronze and brass valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless the alloy is heat treated.

- D. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Block check valves in either closed or open position.

- B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

## PART 2 - PRODUCTS

### 2.1 BASIC, COMMON FEATURES

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated. All valves shall be a full port design.
- C. Valve Actuator Types:
  1. Hand lever: For quarter-turn valves smaller than NPS 4 (DN 100).
- D. Valves in Insulated Piping:
  1. Include 2-inch (50-mm) stem extensions.
  2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
- E. Threads: ASME B1.20.1.
- F. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- G. Solder Joint: ASME B16.18.
  1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for check valves; below 421 deg F for ball valves.

**2.2 BALL VALVES****A. Brass Ball Valves, Two-Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Apollo Flow Controls; Conbraco Industries, Inc.
  - c. Hammond Valve.
  - d. Jomar Valve.
  - e. Legend Valve & Fitting, Inc.
  - f. Milwaukee Valve Company.
  - g. Nibco Inc.
  - h. Watts.
  
2. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: 600 psig (4140 kPa).
  - c. Body Design: Two piece.
  - d. Body Material: Heat treated forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel.
  - i. Port: Full.

**B. Brass Ball Valves, Two-Piece with Full Port and Stainless Steel Trim, Press-Fit Ends:**

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Apollo Flow Controls; Conbraco Industries, Inc.
  - c. Hammond Valve.
  - d. Jomar Valve.
  - e. Legend Valve & Fitting, Inc.
  - f. Milwaukee Valve Company.
  - g. Nibco Inc.
  - h. Watts.
  
- b. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: Minimum 250 psig (1724 kPa).
  - c. Body Design: Two piece.
  - d. Body Material: Heat treated forged brass.
  - e. Ends: Press-fit.
  - f. Press Ends Connections Rating: Minimum 250 psig (1724 kPa).

- g. Seats: PTFE or RPTFE.
- h. Stem: Stainless Steel.
- i. Ball: Stainless Steel.
- j. Port: Full.
- k. O-Ring Seal: Buna-N or EPDM.

C. Bronze Ball Valves, Two-Piece with Full Port and Stainless Steel Trim, Press Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. Hammond Valve.
  - c. Jomar Valve.
  - d. Milwaukee Valve Company.
  - e. Nibco Inc.
  - f. Watts.
- 2. Description:
  - a. Standard: MSS SP-110 or MSS SP-145.
  - b. CWP Rating: Minimum 600 psig (1724 kPa).
  - c. Body Design: Two piece.
  - d. Body Material: Bronze.
  - e. Ends: Press.
  - f. Press Ends Connections Rating: Minimum 250 psig (1724 kPa).
  - g. Seats: PTFE or RPTFE.
  - h. Stem: Stainless Steel.
  - i. Ball: Stainless Steel.
  - j. Port: Full.
  - k. O-Ring Seal: Buna-N or EPDM.

### 2.3 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Valve, Inc.
  - 2. Apollo Flow Controls; Conbraco Industries, Inc.
  - 3. Hammond Valve.
  - 4. Jomar Valve.
  - 5. Milwaukee Valve Company.
  - 6. Nibco Inc.
  - 7. Watts.
- B. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

- C. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.
- D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.

- G. Installation of Check Valves: Install for proper direction of flow as follows:
1. Swing Check Valves: Horizontal position with hinge pin level.
  2. Lift Check Valve: With stem upright and plumb.
- H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- I. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- J. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- K. Press-Connect Joints for Copper Tubing: Join copper tube and pressure-connect fittings with tools recommended by fitting manufacturer.
1. Mark proper insertion depth prior to making press connection.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.3 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
1. Copper Tube Size, 4 Inches and Smaller: Solder ends or threaded ends.
- B. Press-fit valve ends may be substituted in press-fit piping applications.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 4 Inches and Smaller:
1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded, solder or press-fit joint ends.
  2. Bronze ball valves, two-piece with full port and stainless steel trim. Provide with threaded, solder or press-fit joint ends.

**3.5 ADJUSTING**

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

**END OF SECTION 220523**



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**SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract apply to this Section.

## 1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping and equipment.

## 1.3 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports, for piping and equipment.

## 1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

## 1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."
  - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
  - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
- E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
  - 1. Components include galvanized coatings or alternate rust preventing shop coating.
  - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

### 2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic.
  - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

**PART 3 - EXECUTION****3.1 HANGER AND SUPPORT APPLICATIONS**

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

**3.2 HANGER AND SUPPORT INSTALLATION**

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- K. Support all piping direct from structure and independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
  - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
  - 3. Shields: Install MSS Type 40, protective shields on insulated piping. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

<u>NPS (Inches)</u>	<u>LENGTH (Inches)</u>	<u>THICKNESS (Inches)</u>
1/4 to 3-1/2	12	0.04
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

- 4. Pipes 6 Inches and Larger: Include shield inserts.
- 5. Insert Material: Length at least as long as the protective shield.
- 6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

**3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

**3.4 METAL FABRICATION**

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedure for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- C. Paint all exposed steel surfaces with one coat of primer and two coats of enamel.

**END OF SECTION 220529**

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**SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

**PART 2 - PRODUCTS****2.1 EQUIPMENT LABELS**

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 4 by 3/4 inch (102 by 19 mm).
6. Minimum Letter Size: 1/2 inch (13 mm).
7. Fasteners: Stainless-steel rivet, self-tapping screws or adhesive.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.



**2.2 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to [partially cover] [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

**2.3 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters.
  - 1. Material: 3/32-inch-thick plastic laminate with black surfaces and a white inner layer.
  - 2. Material: Manufacturer's standard solid plastic.
  - 3. Size: 4 by 3/4 inch (102 by 19 mm).
  - 4. Shape: Rectangular. Fasteners: Stainless-steel rivet, self-tapping screws or adhesive.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

**PART 3 – EXECUTION****3.1 PREPARATION**

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

**3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

**3.3 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Install on ceiling t-bars below above ceiling equipment.

**3.4 PIPE LABEL INSTALLATION**

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
- B. "Directional Flow Arrows" Paragraph below is in compliance with ASME A13.1.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
  - 1. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  - 2. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Safety black.
    - b. Letter Color: White.
  - 3. Natural Gas Piping:
    - a. Background: Safety green.
    - b. Letter Colors: White.

3.5 VALVE-TAG INSTALLATION

- A. Install on ceiling t-bars below above-ceiling valves.

**END OF SECTION 220553**

<b>IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT</b>	<b>02/03/23</b>	<b>220553-4</b>
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**SECTION 220700 – PLUMBING INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes pipe and equipment insulation.

**1.3 DEFINITIONS**

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal resistivity is designated by an r-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour to flow through 1 square foot at mean temperatures indicated.
- E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.
- F. Density: Is expressed in lb./cu.ft.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories. Provide a summary in schedule form of intended insulation material, jacket type, thickness and adhesive type for each pipe using manufacturer's nomenclature.

**1.5 QUALITY ASSURANCE**

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or

other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.

## 1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping systems.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Glass Fiber:
    - a. CertainTeed Corporation.
    - b. Knauf Fiberglass GmbH.
    - c. Manville.
    - d. Owens-Corning Fiberglas Corporation.
    - e. USG Interiors, Inc. - Thermafiber Division.

### 2.2 GLASS FIBER

- A. Material: Inorganic glass fibers, bonded with a thermosetting resin.
- B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.
- C. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
  1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F mean temperature.
  2. Density: 3 pcf minimum.
- D. Adhesive: Produced under the UL Classification and Follow-up service.
  1. Type: Non-flammable, solvent-based.
  2. Service Temperature Range: Minus 20 to 180 deg F.
- E. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

**2.3 ADHESIVES**

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
  - 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.

**2.4 JACKETS**

- A. General: ASTM C 921, Type 1, except as otherwise indicated.
- B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
  - 1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
  - 2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.
- C. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20 mil thick, high-impact, ultra-violet-resistant PVC.
  - 1. Adhesive: As recommended by insulation manufacturer.

**2.5 SEALING COMPOUNDS**

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
  - 1. Water Vapor Permeance: 0.08 perm maximum.
  - 2. Temperature Range: Minus 20 to 180 deg F.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
- B. Follow cement manufacturer's printed instructions for mixing and portions.

**3.2 INSTALLATION, GENERAL**

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
- C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.
- D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.
- E. Install insulation with smooth, straight, and even surfaces.
- F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.
- H. Seal Ends: Taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.
- I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.
- J. Keep insulation materials dry during application and finishing.
- K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
  - 1. Vibration control devices.
  - 2. Testing laboratory labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Sanitary drainage and vent piping. (Drainage piping receiving air conditioning condensate shall be insulated.)
  - 5. Drainage piping located in crawl spaces, unless indicated otherwise.
  - 6. Below grade piping except for hot water piping.
  - 7. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.

### 3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- B. Stagger joints on double layers of insulation.
- C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- D. Apply insulation with a minimum number of joints.
- E. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.

2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.
  3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.
    - a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.
  4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
  5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
  6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.
- F. Wall and Partition Penetration: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- G. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with a U.L. Listed firestopping or fire-resistant joint sealer.
- H. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply pre-molded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
1. Use same material and thickness as adjacent pipe insulation.
  2. Overlap nesting insulation by 2 inches or 1-pipe diameter, which ever is greater.
  3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
  4. Insulate elbows and tees smaller than 3 inches pipe size with pre-molded insulation.
  5. Insulate elbows and tees 3 inches and larger with pre-molded insulation or insulation material segments. Use at least 3 segments for each elbow.
  6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
- I. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments."
- 3.4 GLASS FIBER PIPE INSULATION INSTALLATION
- A. Bond insulation to pipe with lagging adhesive.
  - B. Seal exposed ends with lagging adhesive.
  - C. Seal seams and joints with vapor barrier compound.



**3.5 JACKETS**

- A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inches laps at longitudinal joints and 3-inch-wide butt strips at end joints.
  - 1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound (mastic) and glass tape (glassfab).

**3.6 FINISHES**

- A. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed exterior insulation.

**3.7 APPLICATIONS**

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.
- B. Piping Systems: Unless otherwise indicated, insulate the following piping systems:
  - 1. Domestic cold water.
  - 2. Storm water. Insulate roof drain bodies and above slab rainwater leaders of storm water piping. Includes piping associated roof drains, secondary roof drains and emergency roof drains.
  - 3. Domestic hot water.
  - 4. Recirculated hot water.

**3.8 PIPE INSULATION SCHEDULES**

- A. Schedules:
  - 1. Domestic Cold-Water Piping: 1" rigid fiberglass insulation.
  - 2. Domestic Hot Water and Recirculation Piping:
    - a. 1" rigid fiberglass insulation for piping 1-1/4" and smaller.
  - 3. Storm Drainage Piping: 1" rigid fiberglass insulation.
    - a. Insulate roof drain bodies with 1/2" flexible elastomeric sheets.

**END OF SECTION 220700**

**SECTION 221116 - DOMESTIC WATER PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Piping and fittings.
  - 2. Piping joining materials.
  - 3. Transition fittings.
  - 4. Dielectric fittings.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For transition fittings and dielectric fittings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

**1.5 FIELD CONDITIONS**

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

**1.6 WARRANTY**

- A. Special Limited Warranty: For press-connect fitting and valves, include manufacturer's standard warranty for the following:
  - 1. Warranty Period for Press-Connect Fittings: 50 years from date of Substantial Completion.

2. Warranty Period for Press-Connect Valves: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B88, Type L (ASTM B88M, Type B) water tube, drawn temper.
- B. Soft Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint, press-connect, or threaded ends.
- F. Copper Unions:
  1. MSS SP-123.
  2. Cast-copper-alloy, hexagonal-stock body.
  3. Ball-and-socket, metal-to-metal seating surfaces.
  4. Solder-joint or threaded ends.
- G. Copper Press-Connect Fittings:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc., ApolloXpress.
    - b. NIBCO INC.
    - c. Viega LLC, Propress.
  2. Fittings for NPS 2 (DN 50) and Smaller: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  3. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  4. NPS 2-1/2 thru NPS 4 (DN 65 to DN 100) Fittings: Stainless steel grip ring and EPDM O-ring seal in each end.

5. Press Ends: Un-pressed fitting identification feature to the fitting wall.
6. Sealing Element: EPDM.

H. Cast Copper Alloy Pipe Flanges with Press-Connect Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Viega LLC; ProPress Copper or comparable products by one of the following:
  - a. NIBCO INC.
  - b. Viega LLC, Propress
2. For Types K, L, and M hard copper tubing NPS 1/2 to NPS 4 (DN 15 to DN 100) and soft copper tubing in NPS 1 to NPS 1-1/4 (DN 25 to DN 32).
3. Flanges: ASME B 16.24, Class 150, powder coated steel plate; two-piece design.
4. NPS 2-1/2 thru NPS 4 (DN 65 to DN 100) Fittings: Stainless steel grip ring and EPDM O-ring seal in each end.
5. Housing: Copper or bronze.
6. Press Ends: Un-pressed fitting identification feature to the fitting wall.
7. Sealing Element: EPDM.

### 2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP-5 Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

### 2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

**2.5 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Capitol Manufacturing Company.
    - c. Central Plastics Company.
    - d. HART Industrial Unions, LLC.
    - e. Jomar Valve.
    - f. Matco-Norca.
    - g. WATTS.
    - h. Wilkins.
    - i. Zurn Industries, LLC.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
  4. End Connections: Solder-joint, or press-connect joint, copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Matco-Norca.
    - d. WATTS.
    - e. Wilkins.
    - f. Zurn Industries, LLC.
  2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
  5. End Connections: Solder-joint, threaded, or press-connect, copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products.

- c. Matco-Norca.
  - d. Precision Plumbing Products.
  - e. Victaulic Company.
- 2. Standard: IAPMO PS 66.
  - 3. Electroplated steel nipple complying with ASTM F1545.
  - 4. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C)
  - 5. End Connections: Male threaded or grooved.
  - 6. Lining: Inert and noncorrosive, propylene.

### PART 3 – EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping to permit valve servicing.
- H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- L. Install sleeves for piping penetrations of walls, ceilings, and floors.

- M. Install sleeve seals for piping penetrations of concrete walls and slabs.
- N. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Press-Connect Joints for Copper Tubing: Join copper tube and pressure-connect fittings with tools recommended by fitting manufacturer.
  - 1. Mark proper insertion depth prior to making press connection.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) Use dielectric flange kits.
- D. Dielectric Fittings for NPS 2-1/2 (DN 65) and Larger: Use dielectric flange kits.

**3.4 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  - 5. NPS 3 to NPS 4 (DN 80 to DN 100): 10 feet (3 m) with 1/2-inch (13-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).

**3.5 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.



## 3.6 IDENTIFICATION

- A. Identify system piping and components.
- B. Label pressure piping with system operating pressure.

## 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

- 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
  - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

## 3.8 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

## 3.9 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

**3.10 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
  - 1. Hard or soft copper tube, ASTM B88, Type L (ASTM B88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.
- D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller shall be the following:
  - 1. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B; cast or wrought copper, solder-joint fittings; and [brazed] [soldered] joints.
  - 2. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B); copper press-connect fittings; and press-connect joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be the following:
  - 1. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B; cast or wrought copper, solder-joint fittings; and [brazed] [soldered] joints.
  - 2. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B); copper press-connect fittings; and press-connect joints.
  - 3. Hard copper tube, ASTM B88, Type L (ASTM B88M, Type B); grooved-joint, copper-tube appurtenances; and grooved joints.

**3.11 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 ball valves.
  - 2. Throttling Duty: Use ball valves.
  - 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

**END OF SECTION 221116**

**SECTION 221119 - PLUMBING SPECIALTIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes plumbing specialties for the following:
  - 1. Water distribution systems.
  - 2. Soil, waste, and vent systems.

**1.3 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Water Distribution Piping: 125 psig.
  - 2. Soil, Waste, and Vent Piping: 10-foot head of water.

**1.4 SUBMITTALS**

- A. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components, and piping and wiring connections for the following plumbing specialty products:
  - 1. Thermostatic water mixing valves.
  - 2. Water hammer arresters.
  - 3. Drain trap seals.
  - 4. Hose bibbs and hydrants.
  - 5. Outlet boxes.
  - 6. Cleanouts.
  - 7. Floor drains.
  - 8. Vent terminals, and roof flashing assemblies.
- B. Reports: Specified in "Field Quality Control" Article.
- C. Maintenance Data: For specialties to include in the maintenance manuals. Include the following:
  - 1. Thermostatic water mixing valves.
  - 2. Hydrants.

**1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing specialties and are based on the specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered.
- B. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- C. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled.
  - 1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- D. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- E. Comply with NFPA 70, "National Electrical Code," for electrical components.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Thermostatic Water Mixing Valves:
    - a. Appollo/Conbraco Industries, Inc.
    - b. Bradley Corp.
    - c. Lawler Manufacturing Co., Inc.
    - d. Leonard Valve Co.
    - e. Mark Controls Corp.; Powers Process Controls.
    - f. Symmons Industries, Inc.
  - 2. Outlet Boxes:
    - a. Acorn Engineering Co.
    - b. Guy Gray Manufacturing Co., Inc.
    - c. IPS Corp.
    - d. LSP-Specialty Products Co.
    - e. Oatey Co.
    - f. Plastic Oddities, Inc.
    - g. Symmons Industries, Inc.

3. Wall Hydrants:
  - a. Josam Co.
  - b. Smith: Jay R. Smith Mfg. Co.
  - c. Tyler Pipe; Wade Div.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Woodford Manufacturing Co.
  - f. Zurn Industries, Inc.; Hydromechanics Div.
  
4. Roof Hydrants:
  - a. Mapa MPH-24-FP
  - b. J.R. Smith 5903
  - c. Woodford SRH-MS
  
5. Water Hammer Arresters:
  - a. Josam Co.
  - b. Smith: Jay R. Smith Mfg. Co.
  - c. Tyler Pipe; Wade Div.
  - d. Watts Industries, Inc.;
  - e. Zurn Industries, Inc.; Hydromechanics Div.
  
6. Drain Trap Seals:
  - a. J. R. Smith; Quad Close
  - b. Proset Trap Guard
  - c. Rectorseal Sure Seal
  - d. IPS Green Drain
  
7. Cleanouts:
  - a. Josam Co.
  - b. Mifab
  - c. Smith: Jay R. Smith Mfg. Co.
  - d. Tyler Pipe, Wade Div.
  - e. Watts
  - f. Zurn Industries, Inc., Hydromechanics Div.
  
8. Floor Drains:
  - a. Josam Co.
  - b. Mifab
  - c. Smith: Jay R. Smith Mfg. Co.
  - d. Tyler Pipe, Wade Div.
  - e. Watts
  - f. Zurn Industries, Inc., Hydromechanics Div.

**2.2 THERMOSTATIC WATER MIXING VALVES**

- A. General: ASSE 1070, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
  - 1. Bimetal Thermostat, Operation and Pressure Rating: 125 psig minimum.
  - 2. Liquid-Filled Motor, Operation and Pressure Rating: 100 psig minimum.
- B. Thermostatic Water Mixing Valves: Unit, with the following:
  - 1. Piping of sizes and in arrangement indicated. Include valves and unions.
  - 2. Piping Component Finish: Rough brass.
  - 3. Thermometer: Manufacturer's standard.

**2.3 OUTLET BOXES**

- A. General: Recessed-mounting outlet boxes with fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- B. Ice Maker Outlet Boxes: With hose connection and the following:
  - 1. Box and Faceplate: Plastic.
  - 2. Shutoff Fitting: Supply stop.
  - 3. Supply Fitting: 1/4-inch NPS copper, water tubing.
- C. Condensate Drain Box: Stainless steel box and face plate; hinged and lockable door; 2" drain fitting; 1" dam and 1-1/2" hole in top of box. See drawing detail for piping requirements.
- D. Reinforcement: 2-by-4-inch- or 2-by-6-inch-, fire-retardant-treated-wood blocking between studs.

**2.4 HYDRANTS**

- A. Wall Hydrants: ASME A112.21.3M or ASSE 1019, non-freeze, automatic draining, anti-backflow type, key operation, with 3/4- or 1-inch NPS threaded or solder-joint inlet, and ASME B1.20.7 garden-hose threads on outlet. Include operating key for each hydrant.
  - 1. Type: Recessed.
  - 2. Finish: Nickel bronze.
- B. Roof Hydrants: ASSE 1057, non-freeze, automatic draining with 3/4-inch inlet and garden hose outlet. Include roof flashing and under-deck flange.

**2.5 DRAIN TRAP SEALS**

- A. Drain Trap Seals: Fitting installs in drain body outlets to block sewer gases.

1. ASSE 1072 compliant.
2. HDPE or DBS plastic frame with silicon or EDPM sealing gasket.

## 2.6 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arrestors: Provide water hammer arrestors where indicated on drawings. Unit shall be constructed of stainless-steel bellows arranged in a pressurized expansion chamber and shall have lifetime warranty. Units shall have P.D.I symbol that relates to fixture unit rating.
- B. Hose Bibbs: Bronze body, with renewable composition disc, 1/2- or 3/4-inch NPS threaded or solder-joint inlet. Provide ASME B1.20.7 garden-hose threads on outlet and integral or field-installed, nonremovable, drainable, hose-connection vacuum breaker.
  1. Finish: Rough brass.
  2. Operation: Operating key (handle) type. Include operating key.
- C. Roof Flashing Assemblies: Manufactured assembly made of 4-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe with galvanized steel boot reinforcement, and counterflashing fitting.
- D. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing, as indicated.

## 2.7 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  1. General Use: 4 lb/sq. ft. or 0.0625-inch thickness.
  2. Vent Pipe Flashing: 3 lb/sq. ft. or 0.0469-inch thickness.
  3. Burning: 6 lb/sq. ft. or 0.0937-inch thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.



**2.8 CLEANOUT**

- A. Cleanout: Where plumbing specialties of this designation are indicated, provide products complying with the following and with the Fixture Schedule on the drawings.

1. Applicable Standard: ASME A112.36.2M. ASME A112.3.1.

**2.9 FLOOR DRAIN**

- A. Floor Drain: Where plumbing specialties of this designation are indicated, provide products complying with the following and with Fixture Schedule on drawings:

1. Applicable Standard: ASME A112.21.1M. ASME A112.21.1M floor drain with ASME A112.14.1 backwater valve. ASME A112.3.1.

**PART 3 - EXECUTION****3.1 PLUMBING SPECIALTY INSTALLATION**

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Install hose bibbs with integral or field-installed vacuum breaker.
- C. Install wall hydrants with integral or field-installed vacuum breaker.
- D. Install drain trap seals in drain body outlets as noted.
- E. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
1. Size same as drainage piping up to 4-inch NPS. Use 4-inch NPS for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping 3-inch NPS and smaller and 80 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- F. Install cleanout deck plates, of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.
- G. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- H. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

- I. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- J. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor or as indicated. Size outlets as indicated.
- K. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed.
- L. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- M. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- N. Position floor drains for easy access and maintenance.
- O. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- P. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.
- Q. Secure supplies to supports or substrate.
- R. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated.
- S. Install water-supply stop valves in accessible locations.
- T. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- U. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
- V. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- W. Include reinforcement for recessed and wall-mounting plumbing specialties.
- X. Anchor roof hydrants to roof deck. Anchor in accordance with manufacturer's instructions. Coordinate flashing with roofing installer.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping connections between plumbing specialties and piping specified in other Division 22 sections.

2. Install piping connections indicated between appliances and equipment specified in other Sections; connect directly to plumbing piping systems.
  3. Install piping connections indicated as indirect wastes from appliances and equipment specified in other Sections, to spill over receptors connected to plumbing piping systems.
- B. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction.
- C. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing manufactured from single piece unless large pans, sumps, or other drainage shapes are required.
- B. Burn joints of lead sheets where required.
- C. Solder joints of copper sheets where required.
- D. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- E. Set flashing on floors and roofs in solid coating of bituminous cement.
- F. Secure flashing into sleeve and specialty clamping ring or device.
- G. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
- H. Fabricate and install flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection if indicated.

### 3.4 COMMISSIONING

- A. Before startup, perform the following checks:
1. System tests are complete.
  2. Damaged and defective specialties and accessories have been replaced or repaired.
  3. Clear space is provided for servicing specialties.

- B. Before operating systems, perform the following steps:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open general-duty valves to fully open position.
  - 3. Remove and clean strainers.
  - 4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
- C. Adjust operation and correct deficiencies discovered during commissioning.

### 3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION 221119**

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**SECTION 221123 - WATER DISTRIBUTION PUMPS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following types of water distribution pumps for plumbing systems:
  - 1. In-line circulators.

**1.3 PUMP PERFORMANCE REQUIREMENTS**

- A. Pump Pressure Ratings: At least equal to system maximum operating pressure at point where installed.
- B. Selection Point: All pump design operating points shall be left of the maximum efficiency point on the pump curve. Pump inlet fluid velocity shall not exceed 12 feet per second.

**1.4 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data including certified performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories. Include startup instructions.
- C. Wiring diagrams detailing wiring for power, signal, and control systems differentiating between manufacturer-installed wiring and field-installed wiring.
- D. Product certificates signed by pump manufacturers certifying accuracies under specified operating conditions and compliance with specified requirements.
- E. Maintenance data for each type and size pump specified to include in the Operating and Maintenance Manual.

**1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with provisions of the following:
  - 1. ASME B31.9 "Building Services Piping" for piping materials and installation.
  - 2. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.

3. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
  4. NFPA 70 "National Electrical Code" for electrical components and installation.
- B. Single-Source Responsibility: Obtain same type of pumps from a single manufacturer.
- C. Single-Source Responsibility: Obtain same type of pumps from a single manufacturer with pumps, components, and accessories from a single source. Include responsibility and accountability to answer and resolve problems regarding compatibility, installation, performance, and acceptance of pumps.
- D. Design Criteria: Drawings indicate sizes, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Design Professional. The burden of proof for equality of pumps is on the proposer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store pumps in a clean, dry location.
- B. Retain shipping flange protective covers and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, or other foreign matter.
- D. Comply with pump manufacturer's rigging instructions for handling and supporting.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. In-Line Circulators:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Div., ITT Fluid Technology Corp.
    - c. Grundfos Pumps Corp.
    - d. Taco, Inc.
  2. Aquastats:
    - a. Honeywell
    - b. Johnson
    - c. Robert Shaw
    - d. Barbar Colman

3. Time Clock:
  - a. Honeywell
  - b. Intermatic
  - c. Taco

## 2.2 PUMPS, GENERAL

- A. Water Distribution Pumps: Factory assembled and tested.
- B. Capacities and Characteristics: As indicated.
- C. Motors: NEMA MG 1; single, multiple, or variable speed with type of enclosure and electrical characteristics indicated. Include built-in thermal-overload protection and grease-lubricated ball bearings. Motors are non-overloading within full range of pump performance curves.
- D. Finish: Manufacturer's standard paint applied to factory-assembled and -tested plumbing pump units before shipping.
- E. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

## 2.3 IN-LINE CIRCULATORS

- A. General Description: Horizontal, in line, centrifugal, single stage, rated for 125-psig minimum working pressure and 225 deg F continuous water temperature.
- B. In-Line Circulator: Leakproof, in-line, seal-less, volute-type pump. Include pump and motor assembled on a common shaft in a hermetically sealed unit, without stuffing boxes or mechanical seals. Lubricate sleeve bearing and cool motor by circulating pumped liquid through motor section. Isolate motor section from motor stator windings with a corrosion-resistant, nonmagnetic alloy liner.
  1. Casing: Lead-free bronze or stainless steel; static O-ring seal to separate motor section from motor stator; and, flanged piping connections.
  2. Impeller: Overhung, single-suction, closed or open nonmetallic impeller.
  3. Shaft and Sleeve: Ceramic shaft with carbon-steel bearing sleeve.

## 2.4 GENERAL-DUTY VALVES

- A. Refer to other Division 22 sections for general-duty gate, ball, butterfly, globe, and check valves.

## 2.5 AQUASTATS

- A. General Description: Metal enclosure, strap-on mounting, visible point scale, external adjustment screw, 65F to 200F operating range.



**2.6 TIME CLOCKS**

- A. Seven-day, programming-switch timer with synchronous-timing motor and 7-day dial; continuously charged, nickel-cadmium-battery-driven, 8-hour, power-failure carryover; multiple-switch trippers; minimum of 2 and maximum of 8 signals per day with 2 normally open and 2 normally closed output contacts.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections prior to pump installation.

**3.2 INSTALLATION**

- A. Install pumps according to the manufacturer's written installation instructions.
- B. Install pumps in locations indicated and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping so that weight of piping is not supported by pumps.
- D. Secure aquastat to hot water return piping upstream of circulating pump.

**3.3 CONNECTIONS**

- A. Connect piping to pumps as indicated. Install valves that are same size as piping connecting to pumps.
- B. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- C. Install shutoff valve on suction side of in-line pumps and circulators.
- D. Install check valve and throttling valve on discharge side of in-line pumps and circulators.
- E. Install electrical connections for power, controls, and devices.
- F. Electrical power and control wiring and connections are specified in Division 26 Sections.

**3.4 FIELD QUALITY CONTROL**

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Pump Controls: Set pump controls for automatic start, stop, and alarm operation.

**3.5 COMMISSIONING**

- A. Final Checks Before Startup: Perform the following preventive maintenance operations and checks before startup:
  - 1. Disconnect couplings and check motors for proper rotation. Rotation shall match direction of rotation marked on pump casing.
  - 2. Check that pumps are free to rotate by hand. Pumps for handling hot liquids shall be free to rotate with pump hot and cold. Do not operate pump if bound or if it drags even slightly until cause of trouble is determined and corrected.
  - 3. Check that pump controls are correct for required application.
- B. Starting procedure for pumps with shutoff power not exceeding safe motor power:
  - 1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
  - 2. Open the liquid supply valves if pumps are so fitted.
  - 3. Open circulating line valves if pumps should not be operated against dead shutoff.
  - 4. Start motors.
  - 5. Open discharge valves slowly.
  - 6. Check general mechanical operation of pumps and motors.
  - 7. Close circulating piping valves once there is sufficient flow through pumps to prevent overheating.
  - 8. Set aquastat operating temperature for 5°F less than hot water supply temperature.
  - 9. Set time clock operation as directed by Owner's representative.
- C. When pumps are to be started against closed check valves with discharge gate valves open, steps are same except open discharge gate valves some time before motors are started.

**END OF SECTION 221123**

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**SECTION 221316 - DRAINAGE AND VENT PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes sanitary drainage and vent piping inside building and to locations indicated.

**1.3 DEFINITIONS**

- A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building.
- B. Soil, Waste and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.
- C. The following are industry abbreviations for plastic and other piping materials:
  - 1. PVC: Polyvinyl chloride.
- D. Underground Piping: Piping located below slab or grade and to within 6-inches above slab or grade.

**1.4 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Systems: 10-foot head of water.
  - 2. Sewerage Piping: 10-foot head of water.

**1.5 SUBMITTALS**

- A. Product Data: For each plumbing specialty indicated. Indicate materials, dimensions, and methods of assembly of components for the following plumbing specialty products:
  - 1. Pipe and Fittings.
  - 2. Pipe Couplings.

**1.6 QUALITY ASSURANCE**

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include "NSF" marking for plastic drain and sewerage piping.

**PART 2 - PRODUCTS****2.1 PIPES AND TUBES**

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe: ASTM D 2665, Schedule 40.

**2.2 PIPE AND TUBE FITTINGS**

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Threaded-Fitting, End Connections: ASME B1.20.1.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.

**2.3 JOINING MATERIALS**

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to Division 22 Section for commonly used joining materials.
- C. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.
- D. Transition Couplings for Underground, Non-pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.
  - 1. Sleeve Type for Plain-End Piping: Rubber or elastomeric sleeve and stainless-steel band assembly, fabricated to match outside diameters of piping to be joined. Include the following:
    - a. Heavy Duty, Type 304, stainless steel hubless cast iron coupling.

**PART 3 - EXECUTION****3.1 PIPING APPLICATIONS**

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Soil, Waste, and Vent Piping: Use the following:
  - 1. 6-Inch NPS or smaller: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

**3.2 PIPING INSTALLATION, GENERAL**

- A. Refer to Division 22 Section for basic piping installation.

**3.3 DRAINAGE AND VENT PIPING INSTALLATION**

- A. Make changes in direction for 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 2 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 make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- B. Lay buried building drain 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.
- C. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 2-inch NPS and smaller; 1 percent downward in direction of flow for piping 3-inch NPS and larger.
  - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- D. Install PVC plastic drainage piping according to ASTM D 2665.
- E. Install underground PVC plastic drainage piping according to ASTM D 2321.
- F. Do not install PVC piping in HVAC plenums unless otherwise noted. Install cast iron piping in all plenum locations.

**3.4 JOINT CONSTRUCTION**

- A. Refer to other Division 22 sections for basic piping joint construction.

- B. PVC Piping Joints: Join drainage piping according to ASTM D 2665.
- C. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
  - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs.
- B. Install supports according to Division 22 Section "Hangers and Supports."
- C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- D. Install hangers for PVC plastic piping with the following maximum spacing and minimum rod diameters:
  - 1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
  - 2. 4-Inch NPS: Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
  - 3. 6-Inch NPS: Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
- E. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS and larger.

### 3.7 ACCESSORIES INSTALLATION:

- A. Install accessories according to manufacturer's written instructions and as indicated.

## 3.8 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
    - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gas tight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

## 3.9 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.



- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

**END OF SECTION 221316**

**SECTION 221416 - NATURAL GAS PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes piping, specialties, and accessories for natural gas systems within building and to point indicated.

**1.3 DEFINITIONS**

- A. Low-Pressure Natural Gas Piping: Operating pressure of 0.5 psig or less.
- B. Medium-Pressure Natural Gas Piping: Operating pressure greater than 0.5 psig, but not greater than 2 psig.
- C. High-Pressure Natural Gas Piping: Operating pressure greater than 2 psig, but not greater than 5 psig.
- D. Gas Service: Pipe from gas main or other source to gas point of delivery for building being served. Piping includes gas service piping, gas valve, service pressure regulator, meter bar or meter support, and gas meter.
- E. Gas Delivery Point: Gas meter or service pressure regulator outlet, or gas service valve if gas meter is not provided.

**1.4 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Minimum Working-Pressure Ratings: Except where otherwise indicated, minimum pressure requirements are as follows:
  - 1. Low-Pressure Natural Gas Piping: 2 psig.
  - 2. Medium-Pressure Natural Gas Piping: 20 psig.
  - 3. High-Pressure Natural Gas Piping: 40 psig.
- B. Approximate values of natural gas supplied for these systems are as follows:
  - 1. Heating Value: 1000 Btu/cu. ft.
  - 2. Specific Gravity: 0.6.

**1.5 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each type of natural gas specialty and special-duty valve. Include pressure rating, rated capacity, and settings of selected models.
- C. Coordination Drawings for natural gas piping, including required clearances and relationship to other services for same work areas.
- D. Test reports specified in "Field Quality Control" Article in Part 3.
- E. Maintenance data for natural gas specialties and special-duty valves to include in the operation and maintenance manual.

**1.6 QUALITY ASSURANCE**

- A. Comply with International Fuel Gas Code and NFPA 54, "National Fuel Gas Code," for gas piping materials and components; installations; and inspecting, testing, and purging.
- B. Comply with NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated control devices.
- C. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- D. Listing and Labeling: Provide equipment and accessories specified in this Section that are listed and labeled.
  - 1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- E. Product Options: Drawings indicate size, profiles, connections, dimensional requirements, and characteristics of natural gas piping equipment, specialties, and accessories and are based on specific types and models indicated. Other manufacturers' equipment and components with equal performance characteristics may be considered.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

**1.8 SEQUENCING AND SCHEDULING**

- A. Notification of Interruption of Service: Notify each affected user when gas supply will be turned off.

- B. Work Interruptions: Leave gas piping systems in safe condition when interruptions in work occur during repairs or alterations to existing gas piping systems.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Gas Ball Valves, 2-Inch NPS and Smaller:
    - a. Jomar Valve
    - b. Legend Valve
    - c. Maxitrol Co.
    - d. McDonald: A.Y. McDonald Mfg. Co.
    - e. Milwaukee Valve Co., Inc.
    - f. National Meter.
  2. Gas Valves, 2-1/2-Inch NPS and Larger:
    - a. Mueller Steam Specialty Div.
    - b. Milliken Valve Co., Inc.
    - c. Nordstrom Valves, Inc.
    - d. Olson Technologies, Inc.; Homestead Valve Div.
  3. Gas Pressure Regulators:
    - a. American Meter Co.
    - b. Fisher Controls International, Inc.
    - c. Maxitrol Co.
    - d. Pietro Fiorentini
    - e. Richards Industries, Inc.; Jordan Valve Div.

### 2.2 PIPES AND TUBES

- A. Steel Pipe: ASTM A 53; Type E, electric-resistance welded or Type S, seamless; Grade B; Schedule 40; black. All exposed piping shall be brushed, primed and painted.

### 2.3 PIPE AND TUBE FITTINGS

- A. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends conforming to ASME B1.20.1.
- B. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends conforming to ASME B1.20.1.

- C. Steel Fittings: ASME B16.9, wrought steel, butt-welding type; and ASME B16.11, forged steel.
- D. Steel Flanges and Flanged Fittings: ASME B16.5.
- E. Transition Fittings: Type, material, and end connections to match piping being joined.

## 2.4 JOINING MATERIALS

- A. Common Joining Materials: Refer to Division 22 Sections for joining materials not included in this Section.
- B. Joint Compound and Tape: Suitable for natural gas.
- C. Gasket Material: Thickness, material, and type suitable for natural gas.

## 2.5 VALVES

- A. Gas Valves, 3-Inch NPS and Smaller: 250 psig WOG minimum, equivalent to ASME B16.33, bronze body with chrome plated brass ball and polytetrafluoroethylene (PTFE) seats and seals. Include lever handle or flat head and threaded ends conforming to ASME B1.20.1.

## 2.6 PIPING SPECIALTIES

- A. Gas Pressure Regulators: ANSI Z21.18, single-stage, steel-jacketed, corrosion-resistant pressure regulators. Include atmospheric vent, elevation compensator, with threaded ends conforming to ASME B1.20.1 for 2-inch NPS and smaller and flanged ends for 2-1/2-inch NPS and larger. Regulator pressure ratings, inlet and outlet pressures, and flow volume in cubic feet per hour of natural gas at specific gravity are as indicated.
  - 1. Service Pressure Regulators: Inlet pressure rating not less than natural gas distribution system service pressure.
  - 2. Line Gas Pressure Regulators: Inlet pressure rating not less than system pressure.
  - 3. Appliance Gas Pressure Regulators: Inlet pressure rating not less than system pressure, with capacity and pressure setting matching appliance.
  - 4. Gas Pressure Regulator Vents: Factory- or field-installed corrosion-resistant screen in opening when not connected to vent piping.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Close equipment shutoff valves before turning off gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.
- B. Comply with NFPA 54 Paragraph "Prevention of Accidental Ignition."

**3.2 PIPING APPLICATIONS**

- A. General: Flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating may be used in applications below, except where otherwise indicated.
- B. 5 psig or Less, Natural Gas Systems: Use the following:
  - 1. 2-Inch NPS and Smaller: Steel pipe, malleable-iron threaded fittings, and threaded joints.
  - 2. 2-1/2 Inch NPS and Larger: Steel pipe, butt-welding fittings, and welded joints.

**3.3 VALVE APPLICATIONS**

- A. Use gas stops or valves for shutoff on appliances with 2-inch NPS or smaller low-pressure gas supply.
- B. Use gas valves for shutoff to appliances with 2-1/2-inch NPS or larger low-pressure gas supply and all sizes for medium-pressure gas supply.
- C. Use gas valves of sizes indicated for gas service piping, meters, mains, and where indicated.

**3.4 PIPING INSTALLATIONS**

- A. Refer to Division 22 Sections for basic piping installation requirements.
- B. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
  - 1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves in such spaces.
  - 2. In Floors: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in floors, subject to approval of authorities having jurisdiction. Surround piping cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  - 3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.
  - 4. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
    - a. Exception: Tubing passing through partitions or walls.
  - 5. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.

6. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    - a. Exception: Accessible above-ceiling space specified above.
  - C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of gas meters. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
    1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
  - D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, except where indicated to be exposed to view.
  - E. Install gas piping at uniform grade of 0.1 percent slope upward toward risers.
  - F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
  - G. Connect branch piping from top or side of horizontal piping.
  - H. Install unions in pipes 2-inch NPS and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
  - I. Install dielectric fittings (unions and flanges) with ferrous and brass or bronze end connections, separated by insulating material, where piping of dissimilar metals is joined.
  - J. Install dielectric fittings (unions and flanges) with 2 ferrous end connections, separated by insulating material, at outlet from gas meter and, where indicated, for ferrous piping.
  - K. Install flanges on valves, specialties, and equipment having 2-1/2-inch NPS and larger connections.
  - L. Anchor piping to ensure proper direction of piping expansion and contraction. Install expansion joints, expansion loops, and pipe guides as indicated.
  - M. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- 3.4 JOINT CONSTRUCTION
- A. Refer to Division 22 Sections for basic piping joint construction.
  - B. Use materials suitable for natural gas service.

**3.5 VALVE INSTALLATION**

- A. Install valves in accessible locations, protected from damage.
- B. Tag valves with metal tag indicating piping supplied. Attach tag to valve with metal chain.
  - 1. Refer to Division 22 Sections for valve tags.
- C. Install gas valve upstream from each gas pressure regulator. Where 2 gas pressure regulators are installed in series, valve is not required at second regulator.
- D. Install pressure relief or pressure-limiting devices so they can be readily operated to determine if valve is free; test to determine pressure at which they will operate; and examine for leakage when in closed position.

**3.6 HANGER AND SUPPORT INSTALLATION**

- A. Refer to Division 22 Sections for pipe hanger and support devices.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  - 1. 1/2-Inch NPS: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  - 2. 3/4- and 1-Inch NPS: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 3. 1-1/4-Inch NPS: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 4. 1-1/2- and 2-Inch NPS: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 5. 2-1/2- to 3-Inch NPS: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  - 6. 4-Inch NPS and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- C. Support horizontal, corrugated stainless-steel tubing according to manufacturer's written instructions.
- D. Support vertical pipe and tube at each floor.

**3.7 CONNECTIONS**

- A. Install gas piping next to equipment and appliances using gas to allow service and maintenance.
- B. Connect gas piping to equipment and appliances using gas with shutoff valves and unions. Install gas valve upstream from and within 72 inches of each appliance using gas. Install union or flanged connection downstream from valve. Include flexible connectors when indicated.
- C. Sediment Traps: Install tee fitting with capped nipple in bottom forming drip, as close as practical to inlet for appliance using gas.
- D. Electrical Connections: Wiring is specified in Division 26 Sections.



**3.8 ELECTRICAL BONDING AND GROUNDING**

- A. Install aboveground portions of natural gas piping systems that are upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.
- B. Do not use gas piping as grounding electrode.

**3.9 FIELD QUALITY CONTROL**

- A. Inspect, test, and purge piping according to "Gas Piping Inspection, Testing, and Purging" in NFPA 54 and International Fuel Gas Code.
- B. Test piping for minimum of two hours. Test pressures shall be equal to twice the minimum working pressure ratings shown in section 221416, paragraph 1.4. A.
- C. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- D. Report test results promptly and in writing to the Design Professional and authorities having jurisdiction.
- E. Verify capacities and pressure ratings of gas meters, regulators, valves, and specialties.
- F. Verify correct pressure settings for pressure regulators.
- G. Verify that specified piping tests are complete.

**3.10 ADJUSTING**

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

**END OF SECTION 221416**

**SECTION 223300 - ELECTRIC WATER HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes electric water heaters and accessories.

**1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate dimensions, finishes and coatings, required clearances, methods of assembly of components, and piping and wiring connections.
- C. Shop Drawings showing layout of each unit, including tanks, pumps, controls, related accessories, and piping.
- D. Setting Drawings with templates and directions for installing foundation bolts, anchor bolts, and other anchorages.
- E. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between factory-installed and field-installed wiring.
- F. Product certificates signed by manufacturers of water heaters certifying that their products comply with specified requirements.
- G. Field quality-control installation reports.
- H. Maintenance data for water heaters to include in operation and maintenance manuals. Include startup instructions.

**1.4 QUALITY ASSURANCE**

- A. ASHRAE Standard: Comply with performance efficiencies prescribed in ASHRAE 90.1, "Energy Efficient Design of New Buildings."
- B. NFPA Standard: Comply with NFPA 70, "National Electrical Code," for electrical components.

- C. Listing and Labeling: Provide electrically operated water heaters, controls, and components specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- D. Product Options: Drawings indicate size, profiles, connections, dimensional requirements, and characteristics of water heaters and accessories and are based on specific types and models indicated. Other manufacturers' water heaters and accessories with equal performance characteristics may be considered.

## 1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.
- B. Warranty Period: 3 years after date of Material Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Storage, Electric Water Heaters:
    - a. Bradford White Corp.
    - b. Lochinvar Corp.
    - c. Rheem Mfg. Co.; Rheem Water Heater Div.
    - d. Rheem Mfg. Co.; Ruud Water Heater Div.
    - e. Smith: A.O. Smith Water Products Co.
    - f. State Industries, Inc.
  - 2. Expansion Tanks:
    - a. Amtrol, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Expanflex, Inc.
    - d. Smith: A.O. Smith; Aqua-Air Div.
    - e. State Industries, Inc.

### 2.2 WATER HEATERS, GENERAL

- A. Specified manufacturer's standard components and features are acceptable where specific product requirements are not indicated.

- B. Temperature Control: Adjustable thermostat, except for units where other arrangement is indicated or temperature is regulated by flow-control fitting.
- C. Safety Control: Automatic, high-temperature-limit cutoff device or system on commercial units and where indicated.
  - 1. Include automatic low-water cutoff device or system on commercial units where indicated.
- D. Interior Finish: Materials that comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.
- E. Tappings: Factory fabricated of materials compatible with tank. Include tappings for piping connections, relief valves, pressure gage, thermometer, blow down, and controls as required and others as indicated. Attach tappings to tank before testing and labeling. Include tappings and connections as follows:
  - 1. 2-Inch NPS and Smaller: Threaded ends.
- F. Insulation: Fiberglass, polyurethane foam, or manufacturer's standard that is suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.
- G. Jacket: Steel, with baked-on enamel finish, except where otherwise specified.
- H. Anode Rods: Factory installed, magnesium.
- I. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

### 2.3 STORAGE, ELECTRIC WATER HEATERS

- A. Description: UL 174, storage, electric water heater; with capacity of less than 120 gal., and input not more than 12 kW.
- B. Storage Tank Construction: Steel with 150-psig working-pressure rating.
- C. Heating Elements: 2 electric, screw-in, immersion type.
- D. Temperature Control: Adjustable thermostat for each element. Include wiring arrangement for non-simultaneous operation.
- E. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of light duty water heater.
- F. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.
- G. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.

**2.4 EXPANSION TANKS**

- A. Description: Steel, pressured-rated tanks constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air per charge to minimum system-operating pressure at tank.
- B. Construction: 150-psig working-pressure rating.
- C. Interior Finish: Materials that comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.

**PART 3 - EXECUTION****3.1 CONCRETE BASES**

- A. Install concrete bases of dimensions indicated for water heaters and accessories. Refer to Division 22 Sections.

**3.2 WATER HEATER INSTALLATION**

- A. General: Install water heaters on concrete bases. Set and connect units according to manufacturer's written instructions. Install units plumb, level, and firmly anchored in locations indicated. Maintain manufacturer's recommended clearances. Install so controls and devices are accessible for service.
- B. Anchor water heaters and storage tanks to substrate.
- C. Install temperature and pressure relief valves in top portion of storage water heater tanks and hot-water storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.
- D. Install water heater drain piping as direct waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Sections for drain valves.
- E. Install thermometers on water heater outlet piping. Thermometers are specified in Division 22 Sections.
- F. Install piping adjacent to water heaters to allow service and maintenance.
- G. Arrange for field-applied insulation on equipment and piping not furnished with factory-applied insulation.

**3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Connect hot- and cold-water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union.
  2. Make connections with dielectric fittings where piping is made of dissimilar metals. Dielectric fittings are specified in Division 22 Sections.
- B. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit servicing.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 COMMISSIONING

- A. Perform the following final checks before startup:
1. Fill water heaters with water.
  2. Check that piping system tests are complete.
  3. Check for piping connection leaks.
  4. Check for clear relief valve inlets, outlets, and drain piping.
  5. Check operation of pumps and circulators.
  6. Test operation of safety controls, relief valves, and devices.
- B. Perform the following startup procedures:
1. Energize electric circuits.
  2. Adjust operating controls.
  3. Adjust hot-water-outlet temperature settings.

**END OF SECTION 223300**

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**SECTION 224000 - PLUMBING FIXTURES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes plumbing fixtures and trim, faucets, other fittings, and related components.

**1.3 DEFINITIONS**

- A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

**1.4 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- C. Wiring diagrams from manufacturer for electrically operated units.
- D. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.
  - 1. Exception: Where fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for this category.
- B. Regulatory Requirements: Comply with requirements of 2010 ADA Standards for Accessible Design; regarding plumbing fixtures for physically handicapped people.



- C. Energy Policy Act Requirements: Comply with requirements of Public Law 102-486, "Energy Policy Act," regarding water flow rate and water consumption of plumbing fixtures.
- D. Listing and Labeling: Provide electrically operated fixtures and components specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing fixtures and are based on specific types and models indicated. Other manufacturers' fixtures with equal performance characteristics may be considered.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.
- B. Store plumbing fixtures on elevated platforms in dry location.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

### PART 2 - PRODUCTS

#### 2.1 PLUMBING FIXTURE STANDARDS

- A. Comply with applicable standards below and other requirements specified.
  - 1. Electric Water Coolers: ARI 1010 and UL 399.
  - 2. National Sanitation Foundation Construction: NSF 2.
  - 3. Stainless-Steel Fixtures Other than Service Sinks: ASME A112.19.3M.
  - 4. Vitreous-China Fixtures: ASME A112.19.2M.
  - 5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5 and ASSE 1037.

#### 2.2 LAVATORY/SINK FAUCET STANDARDS

- A. Comply with ASME A112.18.1M and other requirements specified for lavatory, sink, and similar-type-fixture faucet fittings. Include hot- and cold-water indicators; 2.0-gpm-maximum flow rate; and polished, chrome-plated finish; except where otherwise indicated. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
  - 1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.

2. Faucet Hose: ASTM D 3901.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
6. Pipe Threads: ASME B1.20.1.

### 2.3 MISCELLANEOUS FITTING STANDARDS

- A. Comply with ASME A112.18.1M and other requirements specified for fittings, other than faucets. Include polished, chrome-plated finish, except where otherwise indicated. Coordinate fittings with other components and connectors.

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Automatic Flow Restrictors: ASSE 1028.
3. Brass and Copper, Supplies and Tubular Brass: ASME A112.18.1M.
4. Fixed Flow Restrictors: ASSE 1034.
5. Manual-Operation Flushometers: ASSE 1037.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

### 2.4 MISCELLANEOUS COMPONENT STANDARDS

- A. Comply with applicable standards below and other requirements specified for components for plumbing fixtures, equipment, and appliances.

1. Hose-Coupling Threads: ASME B1.20.7.
2. Pipe Threads: ASME B1.20.1.
3. Plastic Toilet Seats: ANSI Z124.5.
4. Supply and Drain Insulation Kits: CABO A117.1.

### 2.5 FITTINGS

- A. Supplies:

1. Manufacturers and Models:
  - a. A. Y. McDonald 2082 Series
  - b. B&K 490 Series
  - c. Brasscraft KTCS Series
  - d. McGuire BV Series
  - e. Watts 894 Series
  - f. Zurn 8800 Series
2. Supply Inlet: Brass pipe or copper tube, size required for final connection.
3. Supply Stops: Chrome-plated brass, angle; chrome-plated brass ball; quarter-turn operation; ½" compression inlet and 3/8" o.d. compression outlet; same size as supply inlet and with outlet matching supply riser, chrome handle.
4. Supply Risers: 3/8" NPS flexible copper tube with knob end. Use chrome-plated tube for exposed applications.

- B. Traps and Wastes:
1. Manufacturers:
    - a. McGuire
    - b. EBC
    - c. Dearborne
    - d. Watts
    - e. Zurn
  2. Traps: Tubular brass with 0.045" (17 ga.) Wall thickness, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.
  3. Continuous Waste: Tubular brass, 0.045" (17 ga.) Wall thickness, with slip-joint inlet, and size to match equipment.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Include supports for plumbing fixtures according to the following:
  1. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall and recessed, box-mounted, electric water coolers.
  2. Fabricate reinforcement from 2-by-4-inch or 2-by-6-inch fire-retardant-treated-wood blocking between studs or 1/4-by-6-inch steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.
- B. Include fitting insulation kits for accessible fixtures according to the following:
  1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
  2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
  3. Fixtures with Offset Drain: Cover hot- and cold-water supplies, offset drain, trap, and waste to wall.
  4. Other Fixtures: Cover exposed fittings below fixture.

**3.3 PLUMBING FIXTURE INSTALLATION**

- A. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.
- C. Install floor-mounted, floor-outlet water closets with fittings and gasket seals.
- D. Install toilet seats on water closets.
- E. Install wall-hanging, back-outlet urinals with gasket seals.
- F. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.
- G. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- H. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- I. Fasten recessed, wall-mounted fittings to reinforcement built into walls.
- J. Fasten wall-mounted fittings to reinforcement built into walls.
- K. Fasten counter-mounting plumbing fixtures to casework.
- L. Secure supplies to supports or substrate within pipe space behind fixture.
- M. Set shower receptors and mop basins in leveling bed of cement grout.
- N. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.
- O. Install water-supply stop valves in accessible locations.
- P. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- Q. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
- R. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

**3.4 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Division 22 Sections.
- B. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules at the end of this Section for fitting sizes and connection requirements for each plumbing fixture.
- C. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.
- D. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Arrange for electric-power connections to fixtures and devices that require power. Electric power is specified in Division 26 Sections.

**3.5 FIELD QUALITY CONTROL**

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

**3.6 ADJUSTING AND CLEANING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

- D. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Include the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.

**3.7 PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

**3.8 WATER CLOSET SCHEDULE - FLUSH VALVE TYPE**

- A. Water Closet: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
  - 2. Vitreous-China Water Closet:
    - a. American Standard, Inc.
    - b. Kohler Co.
    - c. Sloan Valve Co.
    - d. Zurn Plumbing Products
  - 3. Flushometer Valve:
    - a. American Standard.
    - b. Sloan Valve Co.
    - c. Zurn Industries.
  - 4. Toilet Seat:
    - a. Bemis Mfg. Co.
    - b. Centoco Manufacturing Corp.
    - c. Church Seat Co.
    - d. Olsonite Corp.
    - e. Sanderson Plumbing Products, Inc.;
    - f. Sperzel.
    - g. Zurn Plumbing Products
  - 5. Flushometer Valve Operation: Diaphragm.
  - 6. Flushometer Valve Finish: Polished, chrome-plated, exposed metal parts.
  - 7. Flushometer Valve, Water Consumption: Factory set 1.28 gal. maximum per flushing cycle.
  - 8. Flushometer valve components include the following:
    - a. Brass, lever-handle actuation.
    - b. Non-hold-open feature.

9. Toilet Seat: Solid-plastic, water-closet seat with bumpers and hardware, compatible with water closet and as follows:
  - a. Class: Commercial, Extra-Heavy-Duty type, exceeding requirements of Commercial, Standard class.
  - b. Size: Elongated.
  - c. Hinge Type: Self-sustaining check (SC).

### 3.9 URINAL SCHEDULE

- A. Urinal: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
  1. Products: Subject to compliance with requirements, provide one of the following:
  2. Vitreous-China Urinal:
    - a. American Standard, Inc.
    - b. Kohler Co.
    - c. Sloan Valve Co.
    - d. Zurn Plumbing Products
  3. Flushometer Valve:
    - a. American Standard.
    - b. Sloan Valve Co.
    - c. Zurn Industries, Inc
  4. Flushometer Valve Construction: Cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, and vacuum breaker.
  5. Flushometer Valve Operation: Diaphragm.
  6. Flushometer Valve Finish: Polished, chrome-plated, exposed metal parts.
  7. Flushometer Valve, Water Consumption: Factory set 0.5 gal. maximum per flushing cycle.
  8. Flushometer valve components include the following:
    - a. Brass, lever-handle actuation.
    - b. Non-hold-open feature.
  9. Fixture Support: Type I, vertically adjustable, urinal, chair carrier with coupling; heavy-duty, rectangular-steel, upright members; bearing plate; and feet.

### 3.10 LAVATORY SCHEDULE

- A. Lavatory: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
  1. Products: Subject to compliance with requirements, provide one of the following:

2. Vitreous-China Lavatory:
  - a. American Standard, Inc.
  - b. Crane Plumbing
  - c. Kohler Co.
  - d. Sloan Valve Co.
  - e. Zurn Industries.
  
3. Faucet:
  - a. American Standard.
  - b. Chicago Faucet Co.
  - c. Kohler Co.
  - d. Moen.
  - e. Symmons Ind.
  - f. T & S Brass and Bronze Works, Inc.
  - g. Zurn Industries
  
4. Fitting Insulation Kit:
  - a. TRUEBRO, Inc.
  - b. McGuire
  - c. Brocar
  
5. Supplies: See Fittings section of this specification.
6. Faucet Construction: Cast brass with ceramic cartridges and polished chrome finish.
7. Faucet Water Consumption: 1.5 or 0.5 gpm as specified on drawings.
8. Supply Insulation Kit: Molded, soft-plastic covering for supplies from wall to fixture with removable covering for stops and handles. Include manufacturer's standard fasteners, straps, and adhesives.
9. Drain Insulation Kit: Molded, soft-plastic covering for drain piping from fixture to wall. Include manufacturer's standard fasteners, straps, and adhesives.
10. Fixture Support: Type II, concealed arm; vertically adjustable, lavatory, chair carrier with heavy-duty, rectangular-steel, upright members; and feet.

### 3.11 SINK SCHEDULE

- A. Accessible: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the Drawings:
  1. Products: Subject to compliance with requirements, provide one of the following:
  2. Stainless-Steel Sink:
    - a. Elkay Manufacturing Co.
    - b. Just Manufacturing Co.
    - c. Franke Kindred
    - d. Moen



3. Faucet:
  - a. American Standard.
  - b. Chicago Faucet Co.
  - c. Delta Faucet
  - d. Kohler Co.
  - e. Moen
  - f. Symmons Ind.
  - g. T&S Brass and Bronze Works, Inc.
  - h. Zurn Industries
  
4. Fitting Insulation Kit:
  - a. TRUEBRO, Inc.
  - b. McGuire
  - c. Brocar
  
5. Fixture Stainless-Steel Thickness: 18 gauge.
6. Fixture Mounting: Counter, self-rimming.
7. Faucet Construction: See Fixture Schedule for faucet styles.
8. Faucet Water Consumption: 2.0 gpm maximum flow.
9. Drain{s}: 1-1/2-inch removable, stainless-steel strainer bucket with 3-1/2-inch removable, stainless-steel crumb cup with 1-1/2-inch NPS tubular-brass tailpiece.
10. Supplies: See Fittings section of this specification.

### 3.12 MOP-SERVICE BASIN SCHEDULE

- A. Mop-Service Basin: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
  1. Products: Subject to compliance with requirements, provide one of the following:
  2. Mop-Service Basin:
    - a. Fiat Products, Inc.
    - b. Forestone
    - c. Stern-Williams Co., Inc.
  
  3. Faucet:
    - a. American Standard, Inc.
    - b. Chicago Faucet Co.
    - c. Delta Faucet
    - d. Kohler Co.
    - e. Speakman Co.
    - f. T & S Brass and Bronze Works, Inc.
    - g. Zurn Industries
  
  4. Fixture Dimensions: See Plumbing Fixture Schedule on drawings.
  5. Mounting: Floor.
  6. Rim Guard: Manufacturer's standard.

7. Faucet: Widespread, cast brass with supplies on 8-inch centers.
8. Faucet Mounting: Wall, centered on fixture.
9. Stainless wall guard.
10. Faucet Components: Include the following:
  - a. Finish: Rough chrome.
  - b. Handles: Dual lever or 4 arm.
  - c. Supply Stops: Integral, in shanks.
  - d. Spout: With integral vacuum breaker, pail hook, and hose-thread outlet.
  - e. Wall Brace: Assembly with wall bracket and support to faucet spout.
  - f. Hose: 30-inch-minimum, flexible hose with stainless-steel hose wall bracket.
11. Drain: 3-inch NPS with grid strainer.
12. P-Trap: 3-inch NPS drainage piping.
13. Supplies: 1/2-inch NPS copper tubing with supply stop.
14. Reinforcement: Provide for wall-mounting faucet, wall brace, and hose-hook bracket.

### 3.13 ELECTRIC WATER COOLER SCHEDULE

- A. Electric Water Cooler: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Acorn Aqua; Acorn Mfg. Co.
    - b. Elkay Manufacturing Co.
    - c. Halsey Taylor.
    - d. Haws Drinking Faucet Co.
    - e. Oasis
  2. Fixture Type: Bubbler with sensor operated bottler filler.
  3. Fixture Cabinet Material: Stainless steel.
  4. Fixture Mounting: Wall.
  5. Wall Grille: Stainless steel.
  6. Supply: 3/8-inch NPS copper tubing with supply stop.

**END OF SECTION 224000**

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**SECTION 230000 – GENERAL HVAC PROVISIONS****PART 1 – GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes general provisions covering the contract documents for HVAC Systems.

**1.3 DEFINITIONS**

- A. Provide shall mean "Furnish, install and connect."
- B. Piping shall mean "pipe installed with all specified fittings, valves and accessories, and forming a complete system."
- C. HVAC shall mean "Heating, Ventilation and Air Conditioning."

**1.4 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Electrical Coordination: In addition to submittal requirements of other Division 23 Sections, submit a document approved by the project Electrical Contractor certifying that all mechanical equipment being furnished under Division 23 complies with the electrical characteristics of the source power which will be furnished under Division 26.
- C. Extra Materials: Where specification sections call for extra materials (i.e., filters, etc.) submit a complete list of all such materials including total quantities and sizes for review. Delivered quantities will be verified at the completion of the project.
  - 1. Upon delivery of the extra materials to the Owner, an Owner's representative shall sign the materials list certifying receipt.
  - 2. The signed receipt shall be included in the closeout documents.
- D. Model numbers listed on the Mechanical Contract Documents shall not be construed to indicate electrical characteristics. Electrical characteristics of mechanical equipment shall be as indicated on the Electrical Contract Documents (Division 26).

- E. Review of Submittals does not relieve the Contractor of any of the requirements of the Contract Documents. Failure by the Engineer to document errors and omissions in the Contractor's submittals during the Engineer's submittal review does not constitute a waiver of any of the requirements of the original sealed Contract Documents.

#### 1.5 CONTRACTOR QUALIFICATIONS

- A. HVAC Subcontractor shall have a current Class II (Non-restricted) Conditioned Air Contractors License for the state in which the project is being constructed. The Subcontractor shall have as part of the Firm a Service Department qualified to service all systems installed in the project or have a written agreement with a Service Agency qualified to provide such service. The Service Department or Agency shall be on call at all hours. The subcontractor shall have installed at least (within the last five years):
  - 1. Three (3) hydronic water systems of at least 150-tons in size.
  - 2. One heat recovery variable refrigerant flow system of at least 20-tons in size.
  - 3. Three Dx system buildings of at least 100-tons total capacity with more than one system in excess of 5-tons

#### 1.6 PRIOR APPROVALS

- A. Manufacturers References: When reference is made in the Contract Documents to trade names or specific manufacturers and/or models, such reference, unless noted otherwise, is made to designate and identify the quality of materials or equipment to be furnished and is not intended to restrict competitive bidding. If it is desired to use materials or equipment different from those indicated on the Contract Documents, written request for approval must reach the hands of the primary Design Professional at least TEN DAYS prior to the date set for the opening of bids. A copy of the request should also be sent directly to the Engineer. Requests for prior approval of a proposed substitute shall be accompanied by complete technical data supporting the request.

#### 1.7 LAYOUT AND COORDINATION

- A. Layout Basis:
  - 1. The equipment listed on the drawing schedules or in the technical specifications as "basis of design" or "owner preferred" has been used for the physical arrangement of the mechanical systems. When equipment listed as acceptable, equal or equipment which has received "prior approval" is used, it shall be the Contractor's responsibility to provide structural, ductwork, electrical, service clearances, or other changes required to accommodate the substituted equipment. Changes shall be made at no additional cost to the Owner. Submit a list of required changes along with all prior approval requests and shop drawing submittals.
  - 2. The Contract Drawings are intended to show the general arrangement of all mechanical work. They do not show in detail all offsets, fittings and transitions. Examine Drawings, investigate site conditions to be encountered and arrange work accordingly. Furnish all offsets and transitions required.

3. Drawings do not indicate in detail exact configuration of connections for fixtures, equipment and accessories. Final connection shall be as shown on approved Manufacturer's Submittal Drawings. Where Manufacturer's Submittal Drawings conflict with the Contract Documents, confer with the Design Professional for resolution.
  4. Measurement of Drawings by scale shall not be used as dimensions for fabrication. Measurements for locating fixtures, equipment, ductwork, piping and other mechanical items shall be made on the site and shall be based on actual job conditions.
  5. Check space limitations and verify electrical requirements before ordering any mechanical equipment or materials. Place large equipment inside the building prior to the erection of exterior walls where equipment cannot enter finished building openings.
- B. Coordination: Mechanical work shall be coordinated with that of other trades to avoid conflict. The Contractor shall study all plans and specifications for this project and shall notify the Design Professional of any conflict between work under Division 23 and work under other divisions of the Project. Particular attention shall be given to interference between piping, electrical installations, structural systems, building openings and ductwork.
- C. Installation Instructions: Manufacturer's installation instructions for all equipment furnished under Division 23 shall be furnished by the Contractor. Instructions shall be maintained on the jobsite until the project is complete, and then turned over to the Owner.
- D. Operation and Maintenance Instructions: Electronic copies of equipment O&M manuals shall be submitted to the Owner a minimum of 15 days prior to equipment/systems training. An index document indicating project name, project number, building name and contents shall be included. Model and serial numbers of equipment shall be shown on the cover of their respective O&M manual(s). Warranty registration documentation shall be included where applicable, including documentation confirming warranties have been registered with the equipment manufacturer.

## 1.8 PERMITS

- A. Obtain all necessary Permits and Inspections required for the installation of this work and pay all charges incident thereto. Deliver to the Design Professional all certificates of inspection issued by authorities having jurisdiction.
- B. Sewer tap fees, water tap fees, meter fees, Dept. of Labor Fees for Boilers and Pressure Vessels and all other charges for work under Division 23, including charges for meter installation and excess service by the Gas Company or any other utilities shall be paid by the Contractor.

## 1.9 SAFETY

- A. OSHA Requirements applicable to the project shall be complied with at all times.
- B. Manufacturer's Safety Instructions shall be followed in all instances.
- C. Asbestos Containing Materials (ACM) shall not be used on this project.
- D. Refrigerants containing CFC's or HCFS's shall not be used on this project, nor shall any equipment using such refrigerants be incorporated into this project.

- E. Electrical Equipment Clearances: Piping, equipment and other mechanical installations shall not be located within 42" of the front or 36" of the side of any electrical switchboards, panelboards, power panels, motor control centers, electrical transformers or similar electrical equipment. Piping and ductwork shall not pass through or above electrical equipment rooms except as required to serve those rooms.
- F. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches above the floor, roof or grade below. The guard shall extend not less than 30 inches beyond each end of such appliances, equipment, fans, components and roof hatch openings and the top of the guard shall be located not less than 42 inches above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch diameter sphere and shall comply with the loading requirements for guards specified in the International Building Code.

#### 1.10 PROTECTION OF MECHANICAL SYSTEMS AND COMPONENTS DURING CONSTRUCTION

- A. Material storage:
  - 1. All materials and equipment stored on the jobsite shall be elevated above the ground and stored under suitable weather cover. Materials and equipment shall not be situated in areas subjected to localized flooding.
  - 2. Manufacturer's original shipping packaging and protective coverings shall be left in place until the equipment is prepared for installation.
- B. Roof protection: All penetrations through roofs, including roof curbs, piping curbs and roof drainage system elements shall be properly protected during construction to prevent water intrusion into the building. Protective measures could include temporary covers and plugs, as well as other appropriate temporary elements.
- C. Electrical enclosure protection:
  - 1. During construction, all protective covers and other devices shall be left in place that protect against inadvertent contact with live electrical circuits.
  - 2. All warning labels related to electrical and rotating equipment hazards shall be in place prior to energizing mechanical equipment circuits.
- D. Protection of ducts and piping:
  - 1. Maintain temporary closures on the ends of all ducts and pipes as the installation work progresses. Temporary closures include plastic sheeting, tape and appropriate caps and covers.
  - 2. Where debris enters piping during installation, steps shall be taken to clean the interior of the pipe prior to placing in service.
  - 3. Where debris enters ductwork during installation the duct interior shall be cleaned prior to placing in service.

- E. Operation of HVAC systems during construction:
1. Although the operation of the permanent HVAC systems during the construction process is strongly discouraged, the Contractor shall take measures to protect the systems from contamination if they are operated.
  2. When placed in operation during the construction period, all HVAC systems shall have MERV 8 filtration in all standard filter racks throughout the systems. Where so equipped, final filter banks do not have to be in place.
  3. All return and outdoor air intake openings shall be protected with MERV 8 filter material at all points of entry into the duct system. These protections shall be maintained and remain in place until the building is prepared for final inspection.
  4. Prior to final acceptance of the building HVAC systems, the interior of all HVAC unit cabinets shall be thoroughly cleaned to “like-new” condition.

#### 1.11 CODES AND STANDARDS

- A. Mechanical installations shall conform to the current edition (recognized by the State) of the following, in addition to any previously mentioned Codes and Standards.
1. The International Building Code.
  2. The International Mechanical Code.
  3. The International Plumbing Code.
  4. The International Fire Protection Code.
  5. The State Energy Code.
  6. NFPA Standard 70, National Electric Code.
  7. NFPA Standard 90A, Installation of Air Conditioning and Ventilation Systems.
  8. NFPA Standard 101, Code for Safety to Life for Fire in Buildings and Structures.
  9. The FGI Guidelines for Design and Construction of Hospital and Healthcare Facilities.

#### 1.12 ASBESTOS MATERIALS

- A. Contractor is advised there may be **ASBESTOS PRODUCTS** in building(s) which will affect work under this Project. Particular reference is made to piping, equipment and other items that may be modified or removed. It shall be the sole responsibility of Contractor to check for and ascertain presence of asbestos materials where such presence affects work under this Project. Where Contractor ascertains presence of asbestos materials, he shall notify Owner and Engineer in writing of presence of asbestos **BEFORE** beginning any work. Removal of asbestos products shall be the responsibility of Owner **AFTER** he has been notified by Contractor of its presence.
- B. Engineer assumes no responsibility of investigating for presence of **ASBESTOS PRODUCTS** or for verifying presence of asbestos materials, nor does Engineer assume any responsibility for specifying, advising on, or supervising removal of any asbestos products. Contractor and Owner shall hold harmless Engineer in any matters involving presence of, or removal of, asbestos products.



**1.13 INTERRUPTION OF EXISTING SERVICES**

- A. Exercise care so as not to cut any existing utilities or services. Where an existing utility line or service line is cut it shall be repaired to "like-new" condition. Interruption of service shall not be made without prior written permission of the Owner.
- B. Plumbing, Electrical and HVAC system must remain in service during construction. Arrange with the Owner well in advance of shutdowns required for tie-ins. Shutdowns shall be made after normal occupancy hours if so directed by the Owner. No additional monies will be paid for after-hours shutdowns.

PART 2 - PRODUCTS                      Not required for this section.

PART 3 – EXECUTION                      Not required for this section.

**END OF SECTION 230000**

**SECTION 230500 – COMMON WORK RESULTS FOR HVAC**

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract apply to this Section.

## 1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Concrete equipment base construction requirements.
  - 3. Equipment nameplate data requirements.
  - 4. Labeling and identifying mechanical systems and equipment.
  - 5. Non-shrink grout for equipment installations.
  - 6. Field-fabricated metal and wood equipment supports.
  - 7. Installation requirements common to equipment specification Sections.
  - 8. Mechanical demolition.
  - 9. Cutting and patching.
  - 10. Touchup painting and finishing.

- B. Pipe and pipe fitting materials are specified in piping system Sections.

## 1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

**1.4 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for following piping specialties:
  - 1. Identification materials and devices.
- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Prepare coordination drawings of Mechanical Rooms and Yards to a ¼-inch equals 1-foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
  - 1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:
    - a. Planned piping layout including valve and specialty locations and valve stem movement.
    - b. Planned duct systems layout, including elbow radii and duct accessories.
    - c. Clearances for installing and maintaining insulation.
    - d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
    - e. Equipment service connections and support details.
    - f. Exterior wall and foundation penetrations.
    - g. Fire-rated wall and floor penetrations.
    - h. Sizes and location of required concrete pads and bases.
  - 2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
  - 3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
  - 4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

**1.5 QUALITY ASSURANCE**

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."

- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- E. Coordinate all electrical service requirements for mechanical equipment prior to the submittal of shop drawings. Confirm the compatibility of all power services with the equipment being furnished. Confirm compatibility of electrical lugs being provided by the equipment manufacturer with the power wiring being furnished under Division 26. Furnish written documentation that all characteristics have been coordinated with and confirmed by the electrical subcontractor.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 23 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch minimum thickness, except where thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
  - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
  - 3. AWWA C110, rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
- D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

- E. Solder Filler Metal: ASTM B 32.
  - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
- F. Brazing Filler Metals: AWS A5.8.
  - 1. BCuP Series: Copper-phosphorus alloys.
  - 2. BAgl: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvents complying with the following:
  - 1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
  - 2. Chlorinated Poly (Vinyl Chloride) (CPVC): ASTM F 493.
  - 3. Poly (Vinyl Chloride) (PVC): ASTM D 2564.
  - 4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
- K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.
  - 1. Sleeve: ASTM A 126, Class B, gray iron.
  - 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
  - 3. Gaskets: Rubber.
  - 4. Bolts and Nuts: AWWA C111.
  - 5. Finish: Enamel paint.

## 2.3 PIPING SPECIALTIES

- A. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
  - 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
  - 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
  - 3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
  - 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.

5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
    - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
  6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
  7. Brass Fittings: It is acceptable to use brass fittings in lieu of dielectric fittings to transition from ferrous to non-ferrous piping.
- B. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
  2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
  3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
  4. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.
- C. Piping Roof Curbs:
1. Curb and cap shall be constructed of minimum 18-guage galvanized sheet metal with continuous welded seams.
  2. Provide cant-strip at the base of curb for flashing.
  3. Line curb with 1½-inch fiberglass insulation.
  4. Galvanized sheet metal cap shall have welded sheet metal collars (sleeves) for each pipe that allow for installation of insulated pipe.
  5. Seal annular space between pipe/insulation and collar with a flexible weatherproof boot and stainless-steel pipe clamps.
  6. Cap shall be secured to the curb nailer with cadmium plated screws; minimum one per side.

## 2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.
  1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
  2. Location: An accessible and visible location.

- C. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, conforming to ASME A13.1.
- D. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.
- E. Valve Tags: Engraved brass numbered tags on steel chain.
- F. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine sub-core, except when other colors are indicated.
  - 1. Fabricate in sizes required for message.
  - 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
  - 3. Punch for mechanical fastening.
  - 4. Thickness: 1/16 inch, except as otherwise indicated.
  - 5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- G. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:
  - 1. Green: Cooling equipment and components.
  - 2. Yellow: Heating equipment and components.
  - 3. Yellow/Green: Combination cooling and heating equipment and components.
  - 4. Brown: Energy reclamation equipment and components.
  - 5. Blue: Equipment and components that do not meet any of the above criteria.
  - 6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
  - 7. Nomenclature: Include following, matching terminology on schedules as closely as possible:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
- H. Size: Approximately 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.
- I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
  - 1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."



**2.5 GROUT**

- A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
  - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory-packaged.

**2.6 FIRE-STOPPING**

- A. Fire-Resistant Sealant: Provide UL Listed firestopping system for filling openings around penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
  - 1. Specified Technologies, Inc.
  - 2. 3M Corporation
  - 3. Metacaulk.
  - 4. Hilti, Inc.

**PART 3 - EXECUTION****3.1 PIPING SYSTEMS--COMMON REQUIREMENTS**

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 23 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.

- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, exterior walls and where indicated.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
  - 2. Build sleeves into new walls and slabs as work progresses.
  - 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than 6 inches.
    - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
    - c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in other division sections.
      - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
  - 4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation in non-rated floors and partitions, using elastomeric joint sealants. EXCEPTION: Fire rated partition penetrations shall be sealed with U.L. Listed firestopping systems.
- N. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and elastomeric sealant. Size sleeve for 1/2-inch annular clear space between pipe and sleeve for installation of sealant.
  - 1. Install steel pipe for sleeves smaller than 6 inches.
  - 2. Install sheet metal sleeve assembly for sleeves 6 inches and larger.
  - 3. Install cast iron sleeves according to manufacturer's preprinted instructions.

- O. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with U.L. Listed firestopping sealant system.
- P. Verify final equipment locations for roughing in.
- Q. Refer to equipment specifications in other Sections for roughing-in requirements.
- R. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
  - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - 3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
  - 4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
  - 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
    - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
    - c. Align threads at point of assembly.
    - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  - 6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
  - 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
  - 8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
    - a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
    - b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
    - c. Chlorinated Poly (Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
    - d. Poly (Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
    - e. Poly (Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
    - f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.

- S. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
  2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
  3. Install dielectric unions and flanges or brass fittings to connect piping materials of dissimilar metals.

### 3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Design Professional.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.
- F. Equipment and appliances containing evaporators or cooling coils shall be installed with a means of condensate removal in compliance with IMC 307.2. A water level detection device conforming to UL 508 shall be provided for all main condensate pans and be interlocked to de-energize the unit's main fan should the drain pan water level exceed the main drainpipe connection level. Additional measures shall be taken where indicated on drawings or specifications.

### 3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  1. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
  2. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:
    - a. Near each valve and control device.
    - b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.

- c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
  - d. At access doors, manholes, and similar access points that permit view of concealed piping.
  - e. Near major equipment items and other points of origination and termination.
  - f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
3. On piping above removable acoustical ceilings, provide as noted in the previous paragraph, except omit intermediately spaced markers.
- B. Valves: Provide tags on all valves provided under the project. Furnish a typed list of all tags to the Owner at project closeout.
  - C. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.
    1. Lettering Size: Minimum ¼-inch -high lettering for name of unit where viewing distance is less than 2 feet, ½-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to ¾ of size of principal lettering.
    2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.
  - D. Mark all above ceiling devices such as valves, fire dampers, pumps and HVAC equipment with signs located on the ceiling below.
  - E. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.
    1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.
  - F. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

### 3.4 PAINTING AND FINISHING

- A. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Paint all exposed steel surfaces of piping and supports with one coat of primer and two coats of enamel.

**3.5 CONCRETE BASES**

- A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete with 6 x 6 x #10 reinforcing wire mesh. Outdoor concrete bases shall extend a minimum of 4" above grade and be a minimum thickness of 6".

**3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

**3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

**3.8 DEMOLITION**

- A. Disconnect, demolish, and remove work specified under Division 23 and as indicated.
- B. Where pipe, ductwork, insulation, or equipment to remain, is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated pipe and ductwork in its entirety. Cap existing piping and ductwork that remains in place.
- D. Abandoned Work: Cut and remove pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap piping and patch surface to match existing finish.
- E. Removal: Remove indicated equipment, piping and ductwork from the Project site unless noted otherwise.
- F. Where equipment is indicated to be demolished and removed, and utility runouts are not designated for re-use:
  - 1. Remove associated gas hydronic, steam and refrigerant runout piping from the equipment back to the branching point or source unit. Cap remaining pipe and reinsulate as required.

2. Remove associated power wiring and raceway back to circuit protection device. Re-label circuit protection device.
  3. Remove associated control devices, and control wiring.
- G. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- H. Where floor-mounted equipment is removed, concrete pads shall be removed unless designated for re-use.
- I. Remove all hangers, supports and anchors associated with mechanical items being removed. Patch surfaces to match adjacent finishes.

### 3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

### 3.10 GROUTING

- A. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

**END OF SECTION 230500**

**SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes basic requirements for factory-installed and field-installed motors.

**1.3 SUBMITTALS**

- A. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
- B. Factory Test Reports: For specified tests.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

**1.4 QUALITY ASSURANCE**

- A. Comply with NFPA 70.
- B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

**PART 2 - PRODUCTS****2.1 BASIC MOTOR REQUIREMENTS**

- A. Motors shall be manufactured by one of the following:
1. Cutler Hammer
  2. General Electric
  3. Allen Bradley
  4. Furnas
  5. Siemens



6. Square D
  7. Westinghouse
  8. Baldor
  9. U.S. Motors
- B. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage and Phase Rating: Determined by electrical characteristics of circuit to which motor is connected.
- E. Service Factor: According to NEMA MG 1, unless otherwise indicated. All motors shall have a minimum service factor of 1.15.
- F. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding 90% of nameplate ratings or considering service factor.
- G. Enclosure: Open drip-proof, for indoor locations, totally enclosed fan cooled (TEFC) for outdoor locations except as otherwise indicated.

## 2.2 POLYPHASE MOTORS

- A. Description: NEMA MG 1, medium induction motor.
1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
  2. Electric motors shall meet the minimum efficiency requirements of the International Energy Conservation Code.
  3. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
  4. Rotor: Squirrel cage, unless otherwise indicated.
  5. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
  6. Temperature Rise: Match insulation rating, unless otherwise indicated.
  7. Insulation: Class F, unless otherwise indicated.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer. Motors shall be suitable for inverter duty in accordance with NEMA MG 1, Part 31.
1. Critical vibration frequencies are not within operating range of controller output.
  2. Temperature Rise: Match rating for Class B insulation.
  3. Insulation: Class F.
  4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.

- C. Rugged-Duty Motors: Where indicated, motors are totally enclosed with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings are insulated with non-hygroscopic material. External finish is chemical-resistant paint over corrosion-resistant primer.
- D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
  - 1. Measurement of winding resistance.
  - 2. No-load readings of current and speed at rated voltage and frequency.
  - 3. Locked rotor current at rated frequency.
  - 4. High-potential test.
  - 5. Alignment.

### 2.3 SINGLE-PHASE MOTORS

- A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
  - 1. Permanent-split capacitor.
  - 2. Electronically commutated motor.
- B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.
- C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
- D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.
- E. Electronically Commutated Motors:
  - 1. Where indicated, motor shall be an electronically commutated (EC) motor specifically designed for HVAC applications. Where EC motors are indicated, AC induction type motors are not acceptable.
  - 2. EC motors shall be permanently lubricated with heavy-duty ball bearings to match the load and application. Motors shall be prewired to the specified voltage and phase. Internal motor circuitry shall convert AC power supplied into DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC external signal. Motor shall be a minimum of 85% efficient at all speeds.
  - 3. All EC motors shall feature soft-start technology which eliminates inrush current at start-up. The motors will reliably start at any speed setting.
  - 4. EC motor overload protection shall be provided such that, if the motor becomes overloaded, it will automatically reduce its speed until it is no longer overloaded. If the motor encounters a locked-rotor scenario, the motor shall automatically shut itself down. After shutdown, motor will attempt to restart up to 3 times, and if after the 3rd time the motor will still not rotate, the motor will not attempt to start again until power is cycled.

5. EC motors shall have a one-shot fuse thermal protector, intended to protect the motor from a severe temperature rise. Additionally, the motors shall have on-board temperature sensors which will reduce the speed of the motor should it become too hot.

#### 2.4 SHAFT GROUNDING RINGS

- A. Manufacturers: Shaft grounding rings shall be manufactured by AEGIS.
- B. Description: Rings installed over motor shafts designed to divert bearing currents to ground by providing a reliable shaft grounding path through the motor frame.
  1. Construction: Solid or split rings with 2 rows of conductive microfibers externally or internally mounted to the motor frame.

### PART 3 - EXECUTION

#### 3.1 ADJUSTING

- A. Use adjustable motor mounting bases for belt-driven motors.
- B. Align pulleys and install belts.
- C. Tension according to manufacturer's written instructions.

#### 3.2 APPLICATIONS

- A. Shaft grounding rings shall be installed on all motors 5 hp and larger controlled by variable frequency drives.

#### 3.3 INSTALLATION

- A. Shaft grounding rings may be factory installed by the motor manufacturer or field installed. Field installations shall be in accordance with the shaft grounding ring manufacturer's written instructions for each specific motor.

**END OF SECTION 230513**

**SECTION 230514 - MOTOR CONTROLLERS FOR HVAC EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes ac motor-control devices for mechanical equipment rated 600 V and less that are supplied as enclosed units.

**1.3 SUBMITTALS**

- A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- C. Maintenance Data: For products to include in the maintenance manuals.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Maintain, within 150 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Field Testing Agency Qualifications: An independent testing agency with experience and capability to satisfactorily conduct testing indicated without delaying the Work. Evaluation criteria shall be according to ASTM E 699.
- C. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.
- D. Comply with NFPA 70.
- E. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

**1.5 COORDINATION**

- A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.
- B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

**1.6 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Spare Fuses and Incandescent Indicating Lamps: Furnish 1 spare for every 5 installed units, but not less than 1 set of 3 of each kind.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Manual and Magnetic Motor Controllers:
    - a. ABB
    - b. Allen-Bradley Co.; Industrial Control Group.
    - c. Cerus Industrial
    - d. Cutler-Hammer Products.
    - e. Danfoss Graham
    - f. General Electric
    - g. Siemens Energy & Automation, Inc.
    - h. Square D.
  - 2. Electronic Motor Controllers:
    - a. ABB
    - b. Allen-Bradley Co.; Industrial Control Group.
    - c. Cutler-Hammer Products.
    - d. Danfoss Graham
    - e. Emerson
    - f. General Electric
    - g. Honeywell
    - h. Siemens Energy & Automation, Inc.
    - i. Square D.
    - j. Yaskawa

**2.2 MANUAL MOTOR CONTROLLERS**

- A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

**2.3 MAGNETIC MOTOR CONTROLLERS**

- A. Combination starters shall be furnished for all three phase motors, (unless specifically noted otherwise) and single-phase motors which are automatically started.
- B. Starters shall be NEMA type and shall provide protection on all three phases.
- C. Starters shall be magnetic across the line FVNR with "H-O-A" selector switch, red run pilot and fused disconnect.
- D. Each starter shall have an individual control circuit transformer, line voltage primary, 120 volt secondary, with one fuse in the ungrounded side of the secondary. The transformer shall have 100% space capacity. Where electrical interlocking is involved, a separate contact on the circuit breaker disconnect shall open the interlock circuit. All sources of power to each combination starter shall be deenergized when the lockable circuit breaker disconnect is opened.
- E. Starters for single phase motors not automatically started shall be manual type with thermal protection.

**2.4 VARIABLE FREQUENCY CONTROLLERS (VARIABLE FREQUENCY DRIVES)**

- A. VFD Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
  2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- B. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
  2. Input AC Voltage Unbalance: Not exceeding 3 percent.
  3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
  4. Minimum Efficiency: 97 percent at 60 Hz, full load.

5. Ambient Temperature Rating: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).
  6. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
  7. Humidity Rating: Less than 95 percent (noncondensing).
  8. Altitude Rating: Not exceeding 3300 feet (1005 m).
  9. Vibration Withstand: Comply with IEC 60068-2-6.
  10. Starting Torque: Minimum 100% of rated torque from 3 to 60 Hz.
  11. Speed Regulation: Plus or minus 5percent.
  12. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- D. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
- E. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 0.1 to 999.9 seconds.
  4. Deceleration: 0.1 to 999.9 seconds.
  5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- F. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
  2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
  3. Under- and overvoltage trips.
  4. Inverter overcurrent trips.
  5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
  6. Critical frequency rejection, with three selectable, adjustable dead-bands.
  7. Instantaneous line-to-line and line-to-ground overcurrent trips.
  8. Loss-of-phase protection.
  9. Reverse-phase protection.
  10. Short-circuit protection.
  11. Motor overtemperature fault.
- G. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Auto-speed Search" feature is available and engaged.

- I. Bidirectional Auto-speed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- J. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- L. Integral Input Disconnecting Means and OCPD: NEMA AB 1, circuit breaker with pad-lockable, door-mounted handle mechanism.
  - 1. Disconnect Rating: Not less than 115 percent of VFD input current rating.
  - 2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.
  - 3. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
  - 4. NC alarm contact that operates only when circuit breaker has tripped.
- M. Controls and Indication:
  - 1. Status Lights: Door-mounted LED indicators displaying the following conditions:
    - a. Power on
    - b. Run
    - c. Overvoltage
    - d. Line fault
    - e. Overcurrent
    - f. External fault
  - 2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
    - a. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
    - b. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
      - 1) Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.
  - 3. Historical Logging Information and Displays:
    - a. Real-time clock with current time and date.
    - b. Running log of total power versus time.
    - c. Total run time
    - d. Fault log, maintaining last four faults with time and date stamp for each.



4. Indicating Devices: Digital display mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
    - a. Output frequency (Hz)
    - b. Motor speed (rpm)
    - c. Motor status (running, stop, fault)
    - d. Motor current (amperes)
    - e. Motor torque (percent)
    - f. Fault or alarming status (code)
    - g. PID feedback signal (percent)
    - h. DC-link voltage (V dc)
    - i. Set point frequency (Hz)
    - j. Motor output voltage (V ac)
  
  5. Control Signal Interfaces:
    - a. Electric Input Signal Interface:
      - 1) A minimum of two programmable analog inputs.
      - 2) A minimum of six multifunction programmable digital inputs.
  
    - b. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
      - 1) to 10-V dc.
      - 2) 4- to 20-mA dc
      - 3) Potentiometer using up/down digital inputs
      - 4) Fixed frequencies using digital inputs.
  
    - c. Output Signal Interface: A minimum of one programmable analog output signal which can be configured for any of the following:
      - 1) Output frequency (Hz).
      - 2) Output current (load).
      - 3) DC-link voltage (V dc).
      - 4) Motor torque (percent).
      - 5) Motor speed (rpm).
      - 6) Set point frequency (Hz).
  
  6. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFD status and alarms. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory.
    - a. Network Communications Ports: Ethernet.
    - b. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet; protocols accessible via the communications ports.
- N. Line Conditioning and Filtering:
1. Output Filtering: Furnish DVDT filter where power wiring between VFD and motor exceeds 50 feet in length.

**2.5 ENCLOSURES**

- A. Description: Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

**2.6 ACCESSORIES**

- A. Devices are factory installed in controller enclosure, unless otherwise indicated.
- B. Pilot Lights and "Hand-Off-Auto" Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break push-button station with a factory-applied hasp arranged so a padlock can be used to lock push button in depressed position with control circuit open.
- D. Factory mounted with Nationally Recognized Testing Laboratory listed and labeled mounting device.

**PART 3 - EXECUTION****3.1 APPLICATIONS**

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.
- C. Push-Button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.
- D. Hand-Off-Automatic Selector Switches: In covers of controllers of motors started and stopped by automatic controls or interlocked with other equipment. Also, furnish "run" light in cover.

**3.2 INSTALLATION**

- A. Install independently mounted motor-control devices according to manufacturer's written instructions.
- B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.

- C. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.
- D. 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 conforming to Division 26 Section.
- E. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

### 3.3 IDENTIFICATION

- A. Identify motor-control components and control wiring according to Division 23 Sections.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Division 26.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic control devices where available.
  - 1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
  - 2. 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, fire-related cutouts and motor overload protectors.

### 3.5 CONNECTIONS

- A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.6 PROGRAMMING

- A. Coordinate all programming of variable frequency drives between the drive manufacturer and the control system provider. Furnish all interface devices as required to affect communication between the VFD and the control system.
- B. VFD programming shall include the coordination of operational speed ranges with those allowed by the manufacturer of the drive equipment.
  - 1. VFD shall not drive equipment such that it operates at critical frequencies (harmonics.)
  - 2. VFD shall not drive equipment at speeds which do not provide for proper cooling or lubricant circulation.

**3.7 FIELD QUALITY CONTROL**

- A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
  - 2. Remove and replace malfunctioning units with new units, and retest.

**3.8 CLEANING**

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

**END OF SECTION 230514**

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**SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawing and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes hangers and supports for mechanical systems piping and equipment.

**1.3 DEFINITIONS**

- A. Terminology used in this Section is defined in MSS SP-90.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design seismic restraint hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

**1.5 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

**1.6 QUALITY ASSURANCE**

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."
  - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
  - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
- D. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.
- E. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
  - 1. Components include galvanized coatings or alternate rust preventing shop coating.
  - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

### 2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.

- D. Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic.
  - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Water: Potable.
  - 4. Packaging: Premixed and factory-packaged.

### PART 3 - EXECUTION

#### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

#### 3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.



- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- K. Support all piping direct from structure and independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
  - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
  - 3. Shields: Install MSS Type 40, protective shields on insulated piping. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

<u>NPS (Inches)</u>	<u>LENGTH (Inches)</u>	<u>THICKNESS (Inches)</u>
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075

- 4. Pipes 6 Inches and Larger: Include shield inserts.
- 5. Insert Material: Length at least as long as the protective shield.
- 6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

**3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

**3.4 METAL FABRICATION**

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without under-cut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

**3.5 ADJUSTING**

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

**3.6 PAINTING**

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- C. Paint all exposed steel surfaces with one coat of primer and two coats of enamel.

**END OF SECTION 230529**

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**SECTION 230547**  
**SEISMIC BRACING FOR SUSPENDED UTILITIES AND FLOOR MOUNTED EQUIPMENT**

**PART 1 – GENERAL****1.1 SUMMARY**

- A. This section covers seismic restraints for utilities and equipment including HVAC Ductwork, HVAC Piping and HVAC Equipment. Equipment seismic shall be in accordance with IBC 2018 and calculations for anchorage shall be provided per the code.

**1.2 SEISMIC BRACING**

- A. Seismic bracing shall comply with the following standards.
1. Seismic design criteria as indicated on the Structural Drawings.
  2. 2018 International Building Code Chapter 16 Earthquake Loads.
  3. ASCE 7-10
  4. 2018 International Building Code Chapter 17 Structural Tests and Special Inspections.

**1.3 SUBMITTALS**

- A. Submittals should include appropriate details and reflect actual jobsite conditions. Submittal to be wet stamped by a registered structural engineer specialized in the design of seismic restraints and licensed in the state where the project is located.
- B. Jobsite conditions not covered by the manufacturer's design manual shall be engineered on an individual basis and all calculations and details shall be wet stamped by a registered structural engineer specialized in the design of seismic restraints and licensed in the state where the project is located.
- C. Submit seismic bracing layouts for all suspended utilities on shop drawings wet stamped by a registered Structural Engineer specialized in the design of seismic restraints and licensed in the state where the project is located. The basis for the layouts shall be the utility contractors shop drawings, and the addition of the bracing locations shall be the responsibility of this section.
- D. Layout drawings to include:
1. All vertical support and seismic bracing locations.
  2. All vertical support and seismic bracing connections to the structure (Anchorage Manufacturer, Quantity and Size for each location.)
  3. Vertical Support and brace arm reactions at all connection points to the structure (for the Structural Engineer of Record use in checking suitability of the building structure.
  4. Type and size of brace member.
  5. Reference installation detail #'s for vertical support and seismic bracing.

6. Maximum Transverse Lateral and Longitudinal brace spacing for each utility.
7. Seismic accelerations each utility has been designed to resist.
8. Suspended utility max weight per lineal foot (lbs/1f) or max pipe/conduit size at all seismic locations.
9. Minimum all threaded rod size at all seismic locations.

#### 1.4 SPECIFICATION QUALITY ASSURANCE

- A. Where the Component Importance Factor ( $I_p$ ) is greater than 1.0 for any mechanical, electrical, component or system, that system is considered to be a “Designated Seismic System” per Chapter 17 of the 2012 IBC. Each Contractor responsible for the construction of a Designated Seismic System shall submit a written “statement of responsibility”, per the 2012 IBC, to the building official and owner prior to the commencement of work on the system or component.
- B. Upon completion of construction a Quality Assurance Representative of the seismic force resisting system manufacturer / designer shall review the installation of the seismic-force-resisting system and provide documentation indicating conformance to shop drawing seismic restraint layout and with the manufacturer’s installation instructions.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  1. ISAT (International Seismic Application Technology)
  2. Unistrut
  3. Gripple
  4. Tolco
  5. Loos
- B. Material Requirements:
  1. All manufacturer specific components that are part of the seismic- resistance system must be strength tested by third party vendors with test reports available upon request.
  2. All anchors utilized as part of the component anchorage and /or seismic anchorage must comply with ASCE 7-10. Specifically, all anchors must be tested for seismic applications in conformance with ACI 355.2.

#### 2.2 SPECIFICATION DEVIATIONS

- A. Any contractor or manufacturer wishing to deviate for the project code requirements must submit in writing the following:
  1. Deviation requested.
  2. Reason for the deviation to include code or local jurisdiction allowances.
  3. Cost impact for deviation

- B. A manufacturer's letter of exception will not be considered acceptable justification for deviations. Deviations citing differences between SMACNA and IBC/ASCE exclusions as reasoning for deviation will not be considered.

### 2.3 PROJECT SPECIFIC CHARACTERISTICS

- A. Building Seismic Design Category: As indicated on the structural and architectural drawings.
- B. Building Occupancy Category: As indicated on the structural and architectural drawings.
- C. All non-structural mechanical components on this project have an importance factor of 1.0.

## PART 3 – EXECUTION

### 3.1 INSTALLATION OF SEISMIC BRACING

- A. Installation of seismic bracing systems shall be in accordance with manufacturer's instructions and requirements as well as the governing codes cited above.

**END OF SECTION 230547**

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**SECTION 230548 – VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes vibration isolators, vibration isolation bases and vibration isolation roof curbs.

**1.3 SUBMITTALS**

- A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.

**1.4 QUALITY ASSURANCE**

- A. The manufacturer and/or his representative shall select all vibration isolation products in accordance with the Vibration Isolation Schedule listed in these specifications. All products shall provide the specified deflection as indicated based on the actual equipment weights and installation requirements of the approved equipment. The manufacturer shall provide installation instructions for all provided isolators and seismic restraints and bracing. Locations of vibration isolation products shall be coordinated with equipment details shown on the drawings and as specified in these specifications for maximum support locations for piping and other equipment.
- B. All isolation deflections shall be based on ASHRAE 2007 Handbook - HVAC Applications, Chapter 47. The isolation of any mechanical equipment included in these plans that is not specifically covered by these specifications shall be isolated in accordance with Chapter 47, Table 48 as described above.

**1.5 COORDINATION**

- A. Coordinate layout and installation of vibration isolation devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.



**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

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

1. Kinetics Noise Control, Inc. (basis of design)
2. Amber/Booth Company, Inc.
3. Vibration Mountings and Controls
4. Mason Industries
5. Vibration Eliminator

**2.2 ISOLATOR TYPES**

A. Type 4, Floor-Mounted Equipment (non seismic):

1. Vibration isolators shall be free standing, un-housed, laterally stable springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections shown on the Vibration Isolation Schedule or as indicated on the project documents. Springs shall be color coded or otherwise identified to indicate load capacity. In capacities up to 5,000 lbs., springs shall be replaceable. In capacities over 5,000 lbs., springs shall be welded to the top and bottom load plate assemblies. Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with steel leveling bolt lock nut and washer for attachment to the supported equipment. The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.
2. Isolators shall be equal to Kinetics Model FDS

**2.3 BASES, RAILS AND CURBS**

A. Type C, Roof Mounted Equipment Vibration Isolation Rails:

1. Vibration isolation rails shall consist of an extruded aluminum lower support rail, extruded aluminum upper support rail, steel springs located between the support rail and a continuous weatherproof seal located between the upper and lower support rails.
2. Vibration isolation rails shall be fabricated and designed to be installed and secured on top of the standard manufacturers seismically rated roof curb furnished with the equipment or a Type E roof curb as hereinafter specified.
3. Isolation rails shall provide continuous support for the roof-mounted equipment.
4. Isolation rails shall be designed and engineered to provide isolation against casing radiated vibration and structure born vibration from rotating equipment.
5. The steel springs shall consist of large diameter laterally stable steel springs that have a lateral stiffness greater than 1.0 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity.

6. Isolation rails shall have seismic restraints fabricated and attached to the isolation rail assembly to resist the horizontal forces. Seismic restraints shall be certified by the manufacturer and stamped by a registered engineer.
7. Isolation rail assemblies shall include supply and return duct block-outs as an integral part of the isolation rail assembly.
8. Isolation rails shall be equal to Kinetics Model KSR.

**B. Type E, Roof Curbs:**

1. Roof curbs for roof mounted equipment shall be a minimum of 1/2" wide and 14" high and be fabricated from G 90 galvanized steel fully welded at each corner. Curbs shall be fabricated from a minimum of 18-gage steel or heavier as required to support the intended equipment.
2. Curbs shall have fully mitered corners and base plates to secure curb to the support roof steel.
3. Curbs shall be reinforced with internal steel angles to provide a rigid support for the equipment.
4. Curbs shall be insulated with a minimum of 1-1/2" thick 3# density, fiberglass insulation.
5. Curbs shall have a 2"x2" wood nailer attached to the curb top for securing the equipment.
6. Curbs shall be seismically rated for the installation in accordance with the International Building Code. A registered engineer shall stamp submittals.
7. Curbs shall be equal to Curbs Plus Model CPC-3.

## 2.4 SOUND CONTROL PRODUCTS

**A. Acoustical Sound Barrier:**

1. Acoustical sound barrier material shall be installed within the curb area of all roof top units.
2. Barrier material shall be constructed of a vinyl material with a reinforced fiberglass screen loaded with barium sulfate, 1.0 lb per square foot. Tensile strength shall be 300 lbs per inch and tear strength shall be 100 lbs per in.
3. Install 2 layers of acoustical barrier material inside the roof curb. Barrier material shall be cut and uniformed installed inside the curb area on top of the metal roof deck and around the supply and return air ducts.
4. Barrier material shall be equal to Kinetics KNM-100 RB.

**B. Acoustical Duct Wrap Barrier:**

1. Acoustic duct wrap barrier shall be fabricated of a composite material consisting of an acoustic barrier material bonded to a thin layer of aluminum foil on one side and a decoupling layer of fiberglass batting material.
2. Acoustic barrier shall be constructed of 0.10" thick barium sulphate loaded limp vinyl.
3. Barrier material shall have a "K" value of 0.29 and STC rating of 28.
4. Barrier material shall have a nominal density of 1 psf.
5. Barrier material shall be equal to Kinetics Model 100 ALQ-1.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. If the equipment provided is not furnished with integral structural steel supports, mounting feet or lifting lugs, the contractor shall provide miscellaneous steel shapes as required to install or suspend the equipment and attach the vibration isolation devices as specified herein.
- B. Support steel shall include but not be limited to rails, brackets, angles, channels, and similar components.
- C. All equipment specified to be isolated shall be installed and isolators shall be attached to the building structure or floor and the vibration isolators shall be adjusted and leveled so that the vibration isolators are performing properly.
- D. All vibration isolation products, flexible pipe connectors and sound control products shall be installed as outlined in the manufacturer’s printed installation instructions.
- E. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete, and trowel to a smooth, hard finish.
- F. Install pipe isolation connectors at connections for equipment supported on vibration isolators. Install isolation hangers on the first three piping supports adjacent to vibration producing equipment (i.e. air handling units, pumps, etc.).

**3.2 VIBRATION ISOLATION CERTIFICATE OF COMPLIANCE**

- A. The manufacturer’s representative shall be responsible for providing such assistance and supervision as necessary to assure a correct installation and adjustment of vibration isolation products.
- B. The manufacturer’s representative shall visit the installation once all installed items have been completed but prior to the installation of ceilings or walls that may conceal any devices and inspect the installation for compliance with the manufacturer’s installation instructions. Upon satisfaction that all devices are installed correctly, and systems are isolated properly, the representative shall submit a written report outlining the installation as in compliance with these specifications and the manufacturer’s installation instructions.

**3.3 VIBRATION ISOLATION SCHEDULE FOR MECHANICAL SYSTEMS**

<u>Equipment Type</u>	<u>Isolator</u>	<u>Base</u>	<u>Deflection</u>
Roof Mounted HVAC Units or Air Handling Units (10 tons and up)	Type 4	Type C	1.0”

**END OF SECTION 230548**

**SECTION 230593 - TESTING, ADJUSTING, AND BALANCING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
  2. Adjusting total HVAC systems to provide indicated quantities.
  3. Measuring electrical performance of HVAC equipment.
  4. Setting quantitative performance of HVAC equipment.
  5. Verifying that automatic control devices are functioning properly.
  6. Measuring sound and vibration.
  7. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
  2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

**1.3 DEFINITIONS**

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.

- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. CTI: Cooling Tower Institute.
- P. NEBB: National Environmental Balancing Bureau.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

#### 1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- D. Certified Testing, Adjusting, and Balancing Reports: Submit reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

- E. Sample Report Forms: Submit 3 sets of sample testing, adjusting, and balancing report forms.
- F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

### 1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
  - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
  - 3. Certify that the Agent has either tested and balanced systems according to the Contract Documents or that systems are balanced to optimum performance capabilities within design and installation limits.
- C. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- E. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
- F. Test and balance process is not deemed as accepted until a complete report is received free of deficiencies and discrepancies and approved in writing by the Engineer.

### 1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Material Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

### 1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

### 1.8 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Furnish one of the following special warranties:
  - 1. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents.
  - 2. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents.

### PART 2 - PRODUCTS (Not Applicable)

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents.
- D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the

factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- F. Examine system and equipment test reports.
- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Review manufacturer's certification for each piece of HVAC equipment to be tested. Test and balance shall not be performed until certification letters have been obtained.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices operate by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and sensors 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 design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to design values.
- N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

### 3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.



- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.
  - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 7. Windows and doors can be closed so design conditions for system operations can be met.

### 3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or AABC National Standards and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

### 3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

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

- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.

### 3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each air-handling unit component.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as duct silencers under final balanced conditions.
  - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  - 5. Adjust fan speed higher or lower than design with the approval of the Design Professional. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
  - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

- a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using standard measurement practices.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- F. Measure outdoor air flow minimum requirement damper settings as scheduled with controls contractor. Document voltage settings of control damper actuator in the minimum cfm position. For units with CO<sub>2</sub> controls, measure outdoor air flow maximum requirement settings as scheduled with controls contractor. Document voltage setting of control damper actuator in the maximum cfm position. Controls contractor shall provide on-site technical support to modulate outside air damper min/max position with test and balance contractor to accomplish min/max cfm settings for proper unit operation.

### 3.6 BI-POLAR IONIZATION UNITS

- A. Confirm operation of bi-polar ionization units, where installed, using a voltage detector or other means to determine the presence of ions in the airstream. Report any nonconforming units.

### 3.7 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating if high-efficiency motor.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Speed Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

**3.8 CONDENSING UNITS**

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

**3.9 HEAT-TRANSFER COILS**

- A. Dx Coils: Measure the following data for each coil:

1. Dry-bulb temperatures of entering and leaving air.
2. Wet-bulb temperatures of entering and leaving air (for cooling coils).
3. Airflow.
4. Air pressure drop.

- B. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperatures at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kW at full load.
6. Fuse or circuit-breaker rating for overload protection.

- C. Gas Heating Coils:

1. Measure the following data for each coil:
  - a. Nameplate
  - b. Airflow
  - c. Entering and leaving air temperatures at full load.

**3.10 TEMPERATURE TESTING**

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

**3.11 TEMPERATURE-CONTROL VERIFICATION**

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.12 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
  - 2. Air Outlets and Inlets: Minus 10 percent to plus 10 percent.

### 3.13 REPORTING

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

### 3.14 FINAL REPORT

- A. General: Electronic (PDF) format, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of document signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of the instruments used for procedures, along with proof of calibration.
  - 2. Include letters from HVAC equipment manufacturers certifying that each piece of equipment has been installed and commissioned in accordance with manufacturer's recommendations.

- C. Final Report Contents: In addition to the certified field report data, include the following:
1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

3.15 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: Perform testing, adjusting, and balancing procedures during near-peak summer (above 85°F) and during near-peak winter conditions (below 40°F.) Retainage may be held until each season has been tested. Refer to contract documents.

**END OF SECTION 230593**

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**SECTION 230700 – HVAC INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes pipe, duct, and equipment insulation.

**1.3 DEFINITIONS**

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal resistivity is designated by an R-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (R-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour to flow through 1 square foot at mean temperatures indicated.
- E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.
- F. Density: Is expressed in lb./cu.ft.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories. Provide a summary in schedule form of intended insulation material, jacket type, thickness and adhesive type for each pipe, duct or equipment using manufacturer's nomenclature.

**1.5 QUALITY ASSURANCE**

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.



1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

## 1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping and duct systems.
- B. Schedule insulation application after installation and testing of heat trace tape.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Glass Fiber:
    - a. CertainTeed Corporation
    - b. Knauf Fiberglass GmbH
    - c. Manville
    - d. Owens-Corning Fiberglas Corporation
    - e. USG Interiors, Inc. - Thermafiber Division
  2. Flexible Elastomeric Cellular:
    - a. Armaflex; Armacell LLC
    - b. K-Flex; Nomaco K-Flex Corporation
    - c. Aerocel; Aeroflex USA, Inc.

### 2.2 GLASS FIBER

- A. Material: Inorganic glass fibers, bonded with a thermosetting resin.
- B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.
- C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.
  1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.
  2. Density: 3 pcf minimum.

- D. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible blankets.
  - 1. Thermal Conductivity: 0.32 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.
  - 2. Density: 3/4 pcf minimum within building envelope.
  - 3. Density: 1 pcf minimum exterior to building envelope.
- E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
  - 1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F mean temperature.
  - 2. Density: 3 pcf minimum.
- F. Adhesive: Produced under the UL Classification and Follow-up service.
  - 1. Type: Non-flammable - solvent-based.
  - 2. Service Temperature Range: Minus 20 to 180 deg F.
- G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

### 2.3 FLEXIBLE ELASTOMERIC CELLULAR

- A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
  - 1. Tubular Materials: ASTM C 534, Type I.
  - 2. Sheet Materials: ASTM C 534, Type II.
- B. Thermal Conductivity: 0.25 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F.
- C. Coating: Water based latex enamel coating recommended by insulation manufacturer.
- D. Fire Performance Characteristics: Provide material having the following fire performance characteristics as determined by UL in accordance with ASTM Standard E84:

Flame Spread = 25

Smoke Developed = 50

### 2.4 INSULATING CEMENTS

- A. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
- B. Thermal Conductivity: 1.2 Btu x inch/h x sq. ft. x deg F average maximum at 400 deg F mean temperature.
- C. Compressive Strength: 100 psi at 5 percent deformation.

**2.5 ADHESIVES**

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
  - 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
  - 2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

**2.6 JACKETS**

- A. General: ASTM C 921, Type 1, except as otherwise indicated.
- B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
  - 1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
  - 2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

**2.7 ACCESSORIES AND ATTACHMENTS**

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, pre-sized a minimum of 8 ounces per sq. yd.
  - 1. Tape Width: 3 inches.
  - 2. Cloth Standard: MIL-C-20079H, Type I.
  - 3. Tape Standard: MIL-C-20079H, Type II.
- B. Bands:  $\frac{3}{4}$ -inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: Type 304, 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0.007 inch thick.
  - 4. Brass: 0.01 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 14 gage nickel copper alloy, 16 gage, soft-annealed stainless steel, or 16 gage, soft-annealed galvanized steel.
- D. Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inches by 2-inches kraft paper.
- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

**2.8 SEALING COMPOUNDS**

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
  - 1. Water Vapor Permeance: 0.08 perm maximum.
  - 2. Temperature Range: Minus 20 to 180 deg F.
- B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
  - 1. Water Vapor Permeance: 0.02 perm maximum.
  - 2. Temperature Range: Minus 50 to 250 deg F.
  - 3. Color: Aluminum.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
- B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
  - 1. Follow cement manufacturer's printed instructions for mixing and portions.

**3.2 INSTALLATION, GENERAL**

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.
- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
- C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.
- D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.
- E. Install insulation with smooth, straight, and even surfaces.
- F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

- H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45-degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.
- I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.
- J. Keep insulation materials dry during application and finishing.
- K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
  - 1. Fibrous glass ducts.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums, casings, terminal boxes and filter boxes and sections.
  - 4. Flexible connectors for ducts and pipes.
  - 5. Vibration control devices.
  - 6. Testing laboratory labels and stamps.
  - 7. Nameplates and data plates.
  - 8. Pre-insulated access panels and doors in air distribution systems.
  - 9. Sanitary drainage and vent piping. (Drainage piping receiving air conditioning condensate shall be insulated.)
  - 10. Below grade piping.

### 3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- B. Stagger joints on double layers of insulation.
- C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- D. Apply insulation with a minimum number of joints.
- E. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.
  - 3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.
    - a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.
  - 4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.

6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.
- F. Wall and Partition Penetration: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- G. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with a U.L. Listed firestopping or fire-resistant joint sealer.
- H. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.
- I. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply pre-molded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
  1. Use same material and thickness as adjacent pipe insulation.
  2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.
  3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
  4. Insulate elbows and tees smaller than 3 inches pipe size with pre-molded insulation.
  5. Insulate elbows and tees 3 inches and larger with pre-molded insulation or insulation material segments. Use at least 3 segments for each elbow.
  6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
- J. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 23 Section "Hangers and Supports."

### 3.4 BELOW GROUND PIPE INSULATION INSTALLATION

- A. See individual piping sections.

### 3.5 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

- A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.
- B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.
  1. Miter cut materials to cover soldered elbows and tees.
  2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

**3.6 DUCT INSULATION**

- A. Install block and board insulation as follows:
1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
  2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.
- B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:
1. Smaller Than 24 Inches: Bonding adhesive applied in 6 inches wide transverse strips on 12 inches centers.
  2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
  3. Overlap joints 3 inches.
  4. Seal joints, breaks, and punctures with vapor barrier compound and glass tape (glasfab and mastic).

**3.7 JACKETS**

- A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inches laps at longitudinal joints and 3-inch-wide butt strips at end joints.
1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound (mastic) and glass tape (glassfab).
- B. Interior Exposed Insulation: Install continuous glass cloth jackets.
- C. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2-inch overlap at joints. Embed glass cloth between (2) 1/16inch thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

**3.8 FINISHES**

- A. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed exterior insulation.

**3.9 APPLICATIONS**

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.
- B. Piping Systems: Unless otherwise indicated, insulate the following piping systems:
  - 1. Air conditioning condensate drains and sanitary P-traps receiving air conditioning condensate.
  - 2. All refrigerant piping used for split systems with inverter-driven outdoor units (i.e. mini-splits, ductless split systems.)
- C. Duct Systems: Unless otherwise indicated, insulate the following duct systems:
  - 1. Supply, return and outside air ductwork. (Except double-wall spiral duct exposed in occupied building spaces.)
  - 2. Above-ceiling surfaces of all air devices except where pre-insulated.
  - 3. Interior exposed supply, return and outside air ductwork.
  - 4. Relief ductwork between air inlet devices and energy recovery units.
  - 5. Interior exposed and concealed supply fans, air handling unit casings and outside air plenums.

**3.10 PIPE INSULATION SCHEDULES**

- A. General: Furnish insulation vapor barrier on all piping carrying fluids below 60°F.
- B. Schedules:
  - 1. All refrigerant piping used for split systems with inverter driven outdoor units (i.e. mini-splits, ductless split systems): 3/4" flexible elastomeric insulation. Paint exterior insulation with two coats of manufacturer's recommended coating.
  - 2. Air Conditioning Condensate Drain and Humidifier Drain Piping: 3/8" flexible elastomeric insulation (interior applications only).

**3.11 DUCTWORK AND PLENUM INSULATION SCHEDULES**

- A. General: Furnish vapor barrier on all ductwork insulation.
- B. Schedules:
  - 1. Supply, return, and outdoor air ductwork:
    - a. Lined and unlined within building insulation envelope: 2" glass fiber blanket. Seal all joints and penetrations in jacket with glasfab and mastic.
    - b. Outside Building Insulation Envelope: 3" glass fiber blanket or board.
  - 2. Supply, Return and Outdoor Air Ductwork (lined and unlined) Exposed in Mechanical Rooms: 2" glass fiber board.



**3.12 INSULATION EXPOSED IN MECHANICAL ROOMS**

- A. Finish all piping, equipment and ductwork insulation exposed in each mechanical room with a field applied 8 ounce per square yard canvas jacket cemented in place with white lagging adhesive.
- B. Apply PVC pipe fitting covers over canvas.
- C. Paint canvas with two coats of enamel paint. Colors shall be approved by the Design Professional. Piping insulation shall be painted in accordance with the Owner's color scheme.

**END OF SECTION 230700**

**SECTION 230900 - CONTROLS SYSTEM EQUIPMENT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes control equipment for HVAC systems and components.
- B. Related Section: Division 23 Section "Sequence of Operation" contains requirements that relate to this Section.

**1.3 SYSTEM DESCRIPTION**

- A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and direct digital controllers (DDC) operating in a high-speed, peer-to-peer network hosted by a Facility Management System (FMS) server running a webserver software application. System shall be programmed to operate mechanical systems according to sequences of operation indicated or specified.
- B. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The FMS system server shall be accessed using Web browsers over the control system network, the Owner's local area network (LAN), and over the Internet (at the Owner's discretion). Current web browsers shall be capable of accessing the web server including, Google Chrome, Mozilla Firefox, Apple Safari and Microsoft Edge. Contractor shall be responsible for coordination with the Owner's IT staff to ensure that the FMS will perform in the Owner's environment without disruption to any of the other activities taking place on the LAN.
- C. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No additional software or applications shall be required to access graphic and point displays or configure trends, points and controllers. Computer and Mobile Device browsers shall be supported.
- D. FMS contractor shall provide all control panels, power supplies, wiring, conduit, solenoid valves, relays, differential pressure transmitters, differential pressure switches, pressure sensors, interface devices, etc. necessary for a complete and operable automatic control system and for communication through the Owner's LAN.
- E. System shall use the BACnet protocol for communication to the FMS web server and for communication between control modules. I/O points, schedules, setpoints, trends, and alarms specified or on the drawings or identified in the "Sequence of Operation" shall be BACnet objects.

- F. FMS server software shall be licensed to support not less than forty (40) browser users simultaneously. FMS server software shall allow a unique username, and password for each simultaneous user, and shall be configured to provide unique functionality limits for each of the forty (40) simultaneous users. No license or software shall be required on browser devices.
- G. All new digital controls shall interface with the existing FMS server for this building/facility. Integrate new graphics pages into existing web interface in an intuitive manner. A hyperlink to another system software is not acceptable.
- H. The FMS manufacturer's Software Tool(s) required to create, edit, and modify the FMS database, system graphics, system configuration, and sequences of operation, shall be provided as part of this contract. Provide software licenses (if required) for installation of these Software Tools on six (6) of the Owner's computers. Licenses shall be issued to the Owner, not the Contractor. Software licenses shall be paid in advance under this Contract for a minimum of five (5) years.

#### 1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.
- C. Where equipment, controllers or sensors furnished as a part of other mechanical equipment are to be interlocked or interfaced with the control system (FMS) furnished under this section, provide documentation from the equipment manufacturer or supplier indicating all wiring and software requirements have been coordinated and accommodated. Provide references in the FMS diagrams and operational sequences indicating these accommodations. Where equipment controllers are integrated into the FMS via BACnet Protocol, provide the Protocol Implementation Conformance Statement (PICS) for each controller type and indicate which points being incorporated into the FMS are readable or writable, inputs or outputs, and analog or digital.
- D. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.
- E. Shop Drawings containing the following information for each control system:
  - 1. Schematic flow diagram showing fans, pumps, coils, dampers, valves.
  - 2. Each control device labeled with setting or adjustable range of control.
  - 3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.
  - 4. Details of control panel faces, including controls, instruments, and labeling.
  - 5. Written description of sequence of operation.
  - 6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
  - 7. Listing of connected data points, including connected control unit and input device.
  - 8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  10. Software description and sequence of operation.
- F. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring. Furnish wiring diagrams and coordination documentation for all controlled equipment furnished by other suppliers under Division 23.
- G. Maintenance data for control systems equipment to include in the operation and maintenance manual. Include the following:
1. Maintenance instructions and spare parts lists for each type of control device.
  2. Interconnection wiring diagrams with identified and numbered system components and devices.
  3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  5. Calibration records and list of set points.
  6. Manufacturer's literature for flow measurement systems.
- H. Field Test Reports: Procedure and certification of pneumatic control piping system.
- I. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer specializing in control system installations.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance.
- C. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.
- D. Comply with NFPA 90A.
- E. Comply with NFPA 70.
- F. Coordinate equipment selection with Division 26 Section covering Fire Alarm Systems to achieve compatibility with equipment that interfaces with that system.
- G. For web-based control systems, furnish additional password and access license (if required) to the Engineer for a period not less than 1-year from control system start-up.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store equipment and materials inside and protected from weather.
- B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Direct Digital Control (DDC) Systems and Components:
    - a. Automated Logic Corp. (ALC)
    - b. Carrier; i-Vu® System (Owner preferred)
    - c. Trane Co. (The); Tracer™ SC

**2.2 DIRECT DIGITAL CONTROL (DDC) EQUIPMENT**

- A. Overall Conceptual Description
  - 1. The FMS shall be designed entirely for use on intranets and internets. All networking technology shall be off the shelf, industry standard technology fully compatible with other owner provided networks in the facility.
  - 2. All aspects of the user interface shall be accessed via standard web browsers (Chrome, Firefox, or Microsoft Edge). Access shall be via the internet or the Owner's LAN.
  - 3. The user interface shall be complete as described herein, providing complete tool sets, operational features, multi- panel displays, and other display features.
- B. General:
  - 1. The FMS shall consist of a number of controllers and associated equipment connected by industry standard network practices. All communication between Controllers shall be by digital means only.
  - 2. The FMS network shall at minimum comprise of the following:
    - a. Network processing, data storage and communication equipment including file servers (provided under this contract).
    - b. Routers, bridges, switches, hubs, modems and like communications equipment.
    - c. Active processing Controllers included in field panels.
    - d. Intelligent and addressable elements and end devices.
    - e. Third-party equipment interfaces.
    - f. Other components required for a complete and working FMS.

3. The servers and principal network equipment shall be standard products of recognized major manufacturers available through normal PC vendor channels.
4. Provide licenses for all software residing in the FMS system and transfer these licenses to the Owner prior to completion.

C. Network:

1. The FMS Network shall utilize an open architecture capable of all of the following:
  - a. Utilizing standard Ethernet communications and operate at a minimum speed of 10/100 Mb/sec.
  - b. Connecting via BACnet to any controller or controlled device in accordance with ANSI/ASHRAE Standard 135.
2. The FMS network shall support both copper and optical fiber communication media.

D. Controllers:

1. General: Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC) as required to achieve performance specified. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L.
2. Building Controllers (BCs): Each shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.
  - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
  - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
3. Advanced Application Controllers (AACs): Each AAC shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
  - a. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
4. Application Specific Controllers (ASCs): Each ASC shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
  - a. Each ASC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, using the ARCNET or MS/TP Data Link/Physical layer protocol.
  - b. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network.
  - c. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

**E. Downloading and Uploading:**

1. Provide the capability to generate FMS software-based sequences, database items and associated operational definition information and user-required revisions to same at any Browser, and the means to download same to the associated controller.
2. Application software tool used for the generation of custom logic sequences shall be resident in both the application controller and the server(s) where indicated on the drawings.
3. Provide the capability to upload FMS operating software information, database items, sequences and alarms to the designated server(s).
4. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual FMS application.

**2.3 WEB INTERFACE****A. General:**

1. The FMS user interface shall be user friendly, readily understood and shall make maximum use of colors, graphics (including floor plan graphics), icons, embedded images, animation, text-based information and data visualization techniques to enhance and simplify the use and understanding of the FMS by authorized users.
2. User access to the FMS shall be protected by a flexible and Owner re-definable software-based password access protection. Each username shall be individually configurable with capabilities and restrictions relating to abilities (read or write) and specific building areas (wings, floors, entire building, etc.). It shall be possible to designate "read" ability in one area of the building with "write" ability in another area for each specific user.

**B. Fault Detection and Diagnostics:**

1. The system shall automatically monitor the operation of all building management panels and controllers. The failure of any device shall be announced to the Operator.
2. Alarm Processing: System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Sequences of Operation. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
3. Alarm Messages: Alarm messages shall use the English language descriptor for the object in alarm in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying on acronyms or mnemonics.
4. Alarm Reactions: Operator shall be able to configure (by object) what, if any actions are to be taken during an alarm. As a minimum, the workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
5. Alarm and Event log: Operators shall be able to view all system alarms and changes of state from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and delete alarms and archive closed alarms to the workstation or web server hard disk. Provide an audit trail by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

6. In addition to the BACnet alarm services and diagnostics, the FMS shall annunciate application alarms as required by Part 3 herein, the Sequence of Operation, and the Drawings where indicated.
7. The Owner shall have the ability to add or delete any alarm sequences and shall have the ability to route specific alarms from specific points to specific defined usernames.

C. Historical trending and data collection:

1. Trend and store point history data for all FMS points and values as selected by the user.
2. Provide sufficient server space to file all available points within the system for a period of fourteen (14) days in fifteen (15) minute intervals.
3. The trend data shall be stored in a manner that allows custom queries and reports using industry-standard software tools. The data shall also be configurable within the web interface to display trends in a graphic manner utilizing colors, editable data ranges, durations, legends, and axis descriptions.
4. At a minimum, provide the capability to perform statistical functions on the historical database:
  - a. Average.
  - b. Arithmetic mean.
  - c. Maximum/minimum values.
  - d. Range difference between minimum and maximum values.
  - e. Standard deviation.
  - f. Sum of all values.
  - g. Variance.

D. FMS Shop Drawing Graphics: Provide links within the Web Interface to corresponding controller (BC, AAC, and ASC) wiring diagrams pages from the final approved shop drawings.

## 2.4 CONTROL PANELS

A. Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.

1. Fabricate panels of 0.06-inch-thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color.
2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switch; except safety devices. Mount devices with adjustments accessible through front of panel.
3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
4. Controller Diagrams: Provide a diagram inside the control panel indicating which wires landed on each controller correspond to which sensors, actuators, outputs, etc. consistent with corresponding pages within the final approved shop drawings. All hardcopy documents shall be laminated, legible, and permanently affixed inside the panel.
5. Controller Legend: Where controllers have a display screen displaying abbreviated names for sensors, actuators, setpoints, outputs, etc., provide a legend inside the control panel indicating the abbreviated and full name of each item.



## 2.5 SENSORS

- A. Electronic Sensors: Vibration and corrosion resistant, for wall, immersion, or duct mounting as required.
1. Resistance Temperature Detectors or Thermistors:
    - a. Accuracy: Plus or minus 1°F at calibration point.
    - b. Wire: Twisted, shielded-pair cable.
    - c. Insertion Elements in Ducts: Use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
    - d. Averaging Elements in Ducts: Use where ducts are larger than 9 sq. ft. or where prone to stratification, length as required.
    - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
    - f. Room Sensors: Match room thermostats, locking cover.
    - g. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
    - h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
  2. Humidity Sensors: Bulk polymer sensor element.
    - a. Accuracy: 5 percent full range with linear output.
    - b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
    - c. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
  3. Static-Pressure or Differential Pressure Transmitter: Non-directional sensor with suitable range for expected input, temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    - b. Output: 4 to 20 mA or 0 - 10 VDC.
    - c. Building Static-Pressure Range: 0 to 0.25 inch wg.
    - d. Duct Static-Pressure Range: 0 to 5 inches wg.
  4. Differential Pressure Transducer (Velocity Pressure) for airflow measured applications:
    - a. Accuracy: 0.1% or better, of full scale.
    - b. Operating temperature limits: 32 - 122EF.
    - c. Outputs: 0-10 VDC or 4-20 mA.
    - d. Auto-Zero and temperature compensation capability.
  5. Pressure Transmitters: Direct acting for gas, liquid, or steam service, range suitable for system, proportional output 4 to 20 mA or 0 - 10 VDC.
- B. Equipment Operation Sensors: As follows:
1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.

2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psi.
  3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Carbon Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over temperature range of 23 to 130 deg F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, wall mounted.

## 2.6 ROOM THERMOSTATS

- A. Direct Digital Control (DDC) Thermostat: Thermostats shall consist of room temperature sensors with setpoint adjustment means in a wall-mounted enclosure. Furnish with the following:
1. Override button.
  2. Humidity sensing (where indicated on the Drawings).
  3. CO<sup>2</sup> sensing (where indicated on the Drawings).
  4. Sliding scale adjustment.
- B. Room Thermostat Accessories: As follows:
1. Insulating Bases: For thermostats located on exterior walls.
  2. Thermostat Guards: Cage-style, wire thermostat guard to prevent damage of thermostat without limiting operation and adjustment.
  3. Recessed Aspirating Boxes: Where required for flush installation.
  4. Locking Covers: Vented steel box with enamel finish with only temperature indication visible.

## 2.7 SPECIAL PURPOSE THERMOSTATS

- A. Line-Voltage, ON-OFF Thermostats (Fan Control): Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual ON-OFF-AUTO selector switch; UL listed for electrical rating.
1. Equip thermostats, which control electric heating loads directly, with OFF position on dial wired to break ungrounded conductors.
  2. Dead Band: Maximum 2 deg F.
- B. Electric Low-Limit Duct Thermostat (Freezestat): Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet.
  2. Quantity: 1 thermostat for every 20 sq. ft. of coil surface.

- C. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
  2. Quantity: 1 thermostat for every 20 sq. ft. of coil surface.

## 2.8 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  2. Non-spring Return Motors for Valves Larger than 2-1/2 Inches: Size for running torque of 150 inch-pounds and breakaway torque of 300 inch-pounds.
  3. Spring-Return Motors for Valves Larger than 2-1/2 Inches: Size for running and breakaway torque of 150 inch-pounds.
  4. Non-spring-Return Motors for Dampers Larger than 25 sq. ft.: Size for running torque of 150 inch-pounds and breakaway torque of 300 inch-pounds.
  5. Spring-Return Motors for Dampers Larger than 25 sq. ft.: Size for running and breakaway torque of 150 inch-pounds.
- B. Electronic Operators: Select operator for full shutoff at maximum pump differential pressure.

## 2.9 DAMPERS

- A. Dampers: AMCA-rated, parallel or opposed blade design; form frames from not less than 0.1084-inch galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch galvanized steel, with maximum blade width of 8 inches.
1. Blades secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass. Ends sealed against spring-stainless-steel blade bearings. Thrust bearings at each end of every blade.
  2. Operating Temperature Range: From -40 to 200 deg F.
  3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.
  4. For low-leakage applications (outdoor air) as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq. ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 inch-pounds; test in accordance with AMCA 500.

**2.10 RELAYS**

- A. Control relays shall be UL listed plug-in type with dust cover. Contract rating, configuration and coil voltage suitable for application.
- B. Time delay relays shall be UL listed solid state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

**2.11 TRANSFORMERS AND POWER SUPPLIES**

- A. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
- B. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
- C. Unit shall operate between 0 c and 50 c.
- D. Unit shall be UL recognized.

**2.12 SMOKE DETECTORS**

- A. Smoke detectors shall be located in the duct upstream of each smoke or combination fire/smoke damper. Detectors shall also be located on the wall adjacent to each smoke or combination fire/smoke damper located in plenum smoke partition.
- B. In systems of over 2,000 cfm capacity smoke detectors approved for duct installation shall be installed at a suitable location in:
  - 1. The main supply duct downstream of the unit filter and supply fan.
- C. Smoke detectors and duct housings shall be provided under Division 26. Detectors shall be compatible with existing fire alarm system and shall be approved by the Owner.
- D. Detectors and duct housings used to activate smoke dampers and shut down air handlers shall be mounted under Division 23. Detectors shall be mounted in accordance with NFPA 72.
  - 1. Sampling tubes shall extend full width of duct.
  - 2. Provide access door at smoke detector.
  - 3. Test/reset switches for smoke detectors are furnished and installed under Division 26.

**2.13 SMOKE DAMPERS AND COMBINATION SMOKE AND FIRE DAMPERS**

- A. Smoke dampers and combination smoke and fire dampers will be provided under Division 23. Control of dampers shall be under this section (HVAC Controls):
  - 1. A status panel for smoke dampers shall be provided in the ceiling below the individual dampers. Panel shall contain a red neon pilot light that shall be illuminated when damper is closed.
    - a. Provide damper position interlock to ensure that smoke dampers are open 100% before air handling unit fan is started.

**2.14 CONTROL CABLE**

- A. Electronic Cable for Control Wiring: Refer to Division 26 Sections.
- B. Optical-Fiber Cable for Control Wiring: Refer to Division 26 Sections.

**2.15 AIRFLOW CONTROL SYSTEMS (KITCHEN RANGEHOOD)**

- A. Kitchen Rangehood Systems:
  - 1. Controls for kitchen rangehood fans, makeup air units, and fire suppression systems shall be furnished under other specification sections. Control wiring and control startup/commissioning shall be under this section. Provide additional wiring, relays, control transformers, and other devices as required to make the systems operational and integrate with building power and fire alarm systems.
  - 2. See Sequence of Operation Sections for specific sequences.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verify that field end devices and wiring are installed before proceeding with installation.

**3.2 INSTALLATION**

- A. Install equipment as indicated to comply with manufacturer's written instructions.
- B. Install software in control units and FMS server. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve the sequence of operation specified.

- D. Verify location of thermostats and other exposed control sensors with plans and room details before installation.
    - 1. Install wall-mounted thermostats 4'-6" A.F., unless indicated otherwise. Coordinate mounting height with Architect.
    - 2. Install wall-mounted thermostats minimum 8" away from door or window frames. Coordinate location with switches and other devices provided under other Divisions.
  - E. Provide locking covers on thermostats in the following locations:
    - 1. Entrances.
    - 2. Other public areas.
    - 3. Other areas indicated on the Drawings.
  - F. Provide guards on thermostats in the following locations:
    - 1. Gymnasium.
    - 2. Other areas indicated on the Drawings.
  - G. Install damper motors on outside of duct in warm areas, not where exposed to outdoor temperatures.
  - H. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
  - I. Install labels and nameplates to identify control components according to Division 23 Sections specifying mechanical identification.
  - J. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
  - K. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
  - L. Install optical-fiber cable according to Division 26 Sections.
- 3.3 FLOW MEASURING SYSTEM, FLOW ELEMENT AND METER INSTALLATION:
- A. General: Install flow meters for piping systems located in accessible locations at most readable position.
  - B. Locations: Install flow measuring elements and meters at discharge of each pump, at inlet of each hydronic coil in built-up central systems, and elsewhere as indicated.
  - C. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.
  - D. Install connection fittings for attachment to portable flow meters in readily accessible locations.
  - E. Permanently Mounted Meters for Flow Elements: Install meters on walls or brackets in accessible locations.

- F. Install connections, tubing, and accessories between flow elements and meters as prescribed by manufacturer's written instructions.
- G. Connect flow measuring-system elements to meters.
- H. Connect flow-meter transmitters to meters.

### 3.4 ELECTRICAL WIRING AND CONNECTIONS

- A. Install raceways, boxes, and cabinets according to Division 26.
- B. Install building wire and cable according to Division 26.
- C. Install signal and communication cable in EMT, conduit or other raceway according to Division 26.
  - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway.
  - 3. Install concealed cable in raceway.
  - 4. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.
  - 5. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.
- D. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.
- E. Connect manual reset limit controls independent of manual control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- F. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.
- G. Make electrical connections to power supply and electrically operated meters and devices.
- H. Where not indicated otherwise, obtain power for control units from the nearest un-switched receptacle circuit.

### 3.5 COMMISSIONING

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems.
- B. Test and adjust controls and safeties.
- C. Replace damaged or malfunctioning controls and equipment.

- D. Start, test, and adjust control systems.
- E. Demonstrate compliance with requirements.
- F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

**3.6 DEMONSTRATION**

- A. **Manufacturer's Field Services:** Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.
  - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  - 2. Schedule training with Owner with at least 7 days' notice.
  - 3. Provide operator training on data display, alarm and status descriptors, requesting data, execution of commands, and request of logs. Include a minimum of (8) hours dedicated instructor time on-site.

**END OF SECTION 230900**



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**SECTION 230993 - SEQUENCE OF OPERATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes control sequences for HVAC systems and terminal units.
- B. Related Section: Division 23 Section "Control Systems Equipment" contains requirements that relate to this Section.
- C. The Facility Management System (FMS) input/output summary is listed on the Drawings. Furnish listed points plus others required to achieve sequence of operation.
- D. Where equipment is to operate using manufacturer supplied unit-mounted controls, integrate controls into the FMS utilizing a BacNet interface. Provide all necessary hardware and programming.

**1.3 SAFETY AND RELIABILITY SYSTEMS:**

- A. Smoke Detector/Air Handling Unit:
  - 1. In systems with air handling capacity above 2,000 CFM and up to and including 15,000 CFM, the smoke detector mounted in the unit or main ductwork shall, when sensing smoke, shut down the Air Handling Unit. The smoke detectors shall be connected to the fire alarm system. The actuation of smoke detector shall activate a visible and supervisory signal at a constantly attended location. Where an outdoor condensing unit or heat pump is used it shall shut down those components.
  - 2. Air-handling units shall deenergize on any general building fire alarm activation.
  - 3. Integrate new air-handling equipment into the facility's existing fire alarm shutdown sequence.
  - 4. An emergency air handling system shutdown switch shall be located adjacent to the main fire alarm panel. All air handling units shall de-energize whenever the master shutdown switch located at the main fire alarm panel is activated.
- B. Smoke (or Combination) Damper/Smoke Detector: Upon sensing smoke at the detector, the damper shall close. When the damper is closed, the indicator light shall illuminate on the ceiling below the damper.

- C. Upon any fan system (i.e. air handling unit, exhaust fan) shutdown, all smoke dampers (or combination smoke/fire dampers) in that fan system's duct system shall close. Coordinate damper closure sequence/fan system shutdown with fire alarm system contractor. Fan restart shall require damper end switch proof of opening in order to reenergize fan(s).
- D. Auto Restart: All HVAC systems and equipment shall be configured such that normal operation is resumed after a power failure.
- E. Dead Band: Where used to control both heating and cooling, zone thermostats shall be capable of providing a temperature dead band of at least 5°F in accordance with ASHRAE standard 90.1.
- F. Setback/Overrides:
  - 1. All HVAC systems/units shall be scheduled for operation by the DDC system. The occupancy schedule shall be prescribed by the Owner.
  - 2. In unoccupied mode, the temperature setpoint shall be set back to 50°F for heating and 85°F for cooling. Unit supply fans shall run only as required to maintain setback temperatures. Outdoor air dampers shall be closed, and exhaust fans shall not operate.
  - 3. Prior to the occupancy period, the HVAC systems shall energize to cool or warm the spaces to normal occupied setpoint. Outdoor air dampers shall remain closed, and exhaust fans shall remain off during warmup/cool-down.
  - 4. Outdoor air dampers shall open to setpoint, and general exhaust fans shall energize only when setpoint is reached and the building is in occupied mode.
  - 5. Individual HVAC systems shall be equipped with override buttons on the unit thermostats. When the button is activated, the unit shall operate in occupied mode for a period determined by the Owner.

#### 1.4 UNITARY SYSTEMS

- A. Packaged Rooftop Units with single zone control (electric cool/electric heat):
  - 1. When scheduled to run by the FMS, the unit shall energize and run.
  - 2. Outdoor and return air dampers shall modulate to maintain minimum outdoor airflow. During unoccupied mode, outside air damper shall be closed.
  - 3. Unit shall energize heating or cooling stages in response to the room thermostat.
  - 4. Unit shall operate in economizer mode whenever the return air enthalpy exceeds the outdoor air enthalpy. When unit is in economizer mode, the relief fan shall energize to relieve building pressure (where equipped).
  - 5. During times when the unit is off or in warmup mode, the outdoor air damper shall be closed.
  - 6. Unit shall energize in heating mode when it is not scheduled to run, but the zone temperature falls below 50°F.
  - 7. For units equipped with hot gas reheat dehumidification coils, room humidity sensors shall be located in the main return duct adjacent to the unit or unit plenum.
    - a. When the space humidity exceeds 60% Rh (adjustable), the unit shall operate in dehumidification mode. Unit shall energize all cooling stages to reach dehumidification setpoint.
    - b. When in dehumidification mode, if the space temperature falls below the temperature setpoint, the hot gas reheat valve shall send gas to the reheat coil.

**B. Split Systems (ductless):**

1. Split systems shall be controlled by individual thermostats furnished by the manufacturer. Heating or cooling shall be energized as required to maintain space temperature.
2. The systems serving the conference rooms shall be scheduled by the FMS. The systems serving the data room shall be enabled continuously.
3. DDC temperature sensors shall be used for monitoring and alarm in those spaces.

**1.5 HEATING, VENTILATION AND HUMIDIFICATION SYSTEMS****A. Fans: See fan schedule.**

1. Where fans are indicated to be interlocked with room lighting, furnish starters/contactors as required for control operation.
2. Exhaust Fan: Where exhaust fan serves more than a single space; provide a line voltage relay for each room and connect relays in parallel so that turning lights on in any room will start exhaust fan.
3. Exhaust fans controlled by the FMS shall run continuously when the building is occupied. When unoccupied, these fans shall turn off.

**1.6 SUBMITTALS****A. General: Submit the following according to the Conditions of the Contract.**

- B. Shop Drawings showing operating sequences of various equipment, devices, components, and materials included in the Text and defining the components' contribution to the system.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 230993**

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**SECTION 232300 - REFRIGERANT PIPING AND CONDENSATE DRAINS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications, including pipes, tubing, fittings, and specialties; special-duty valves; and refrigerants. It also includes piping used for air conditioning condensate drainage.

**1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each valve type and refrigerant piping specialty specified.
- C. Shop Drawings showing layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
  - 1. Refrigerant piping indicated is schematic only. Size and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.
- D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.
- E. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual.

**1.4 QUALITY ASSURANCE**

- A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with provisions of the following codes:
  - 1. ASME B31.5, "Refrigeration Piping."
  - 2. ASHRAE 15, "Safety Code for Mechanical Refrigeration."

- C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."
- D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

### 1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Refrigerants:
    - a. Allied Signal Inc.; Genetron Refrigerants.
    - b. DuPont Company; Fluorochemicals Div.
    - c. Elf Atochem North America, Inc.
    - d. ICI Americas Inc.; Fluorochemicals Bus.
  - 2. Refrigerant Valves and Specialties:
    - a. Danfoss Electronics, Inc.
    - b. Eaton Corporation; Industrial Control Div.
    - c. Emerson Electric Company; Alco Controls Div.
    - d. Henry Valve Company.
    - e. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
    - f. Sporlan Valve Company.

### 2.2 PIPES AND TUBES

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Copper Tube: ASTM B 88, Type L.

### 2.3 PIPE AND TUBE FITTINGS

- A. Copper Fittings: ASME B16.22, wrought-copper streamlined pattern.

### 2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

**2.5 VALVES**

- A. Solenoid Valves: Conform to ARI 760; 250 deg F temperature rating, 400-psig working pressure; forged brass, with PTFE valve seat, 2-way straight-through pattern, and solder-end connections; manual operator; with NEMA 250, Type 1 solenoid enclosure with 1/2-inch conduit adapter, and 24-V normally closed holding coil.
- B. Pressure-Regulating Valves: Conform to ARI 770; pilot operated, forged brass or cast bronze with pilot operator, stainless-steel bottom spring, pressure-gage tappings, 24-V dc standard coil, and wrought-copper fittings for solder-end connections.
- C. Pressure-Regulating Valves: Conform to ARI 770; direct acting, brass with pilot operator, stainless-steel diaphragm, standard coil, and solder-end connections.
- D. Pressure Relief Valves: Straight or angle brass body and disc, neoprene seat, factory sealed and ASME labeled, for standard pressure setting.
- E. Thermal Expansion Valves: Conform to ARI 750; thermostatic-adjustable, modulating type; size as required and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
- F. Hot-Gas Bypass Valve: Adjustable, sized for capacity equal to last step of compressor unloading; solder-end connections.

**2.6 REFRIGERANT PIPING SPECIALTIES**

- A. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.
- B. Permanent Filter-Dryer: 500-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

**2.7 RECEIVERS**

- A. 6-Inch Diameter and Smaller: ARI 495, UL listed, steel, brazed; 400-psig pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- B. More than 6-Inch Diameter: ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code, Section 8D; 400 psig with tappings for liquid inlet and outlet valves, pressure relief valve, and liquid-level indicator.

**2.8 REFRIGERANT**

- A. ASHRAE 34, R-410-A: Pentofluoroethane Difluouromethane.



**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.2 APPLICATIONS**

- A. Aboveground refrigerant piping: Type ACR copper tubing.
- B. Aboveground condensate drain piping: Type L copper tubing.

**3.3 INSTALLATION**

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23.
- C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in conduit. Vent conduit outdoors.
- G. Insulate refrigerant suction lines and hot gas lines. Insulate all refrigerant lines on inverter-driven split systems and variable refrigerant flow system.
  - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.
- I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- J. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.

3. Install traps and double risers where indicated or where required to entrain oil in vertical runs.
  4. Liquid lines may be installed level.
- K. Use fittings for changes in direction and branch connections.
- L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.
- N. Install refrigerant valves according to manufacturer's written instructions.
- O. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.
- P. Electrical wiring for solenoid valves is provided under Division 23 and specified in Division 26 Sections. Coordinate electrical requirements and connections.
- Q. Mount thermostatic expansion valves in any position, close to evaporator.
1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
  2. Install valve so diaphragm case is warmer than bulb.
  3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
  4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- R. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valves on receivers to outdoors.
- S. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.
- T. Charge system per industry accepted standards for systems utilizing R-410A, or manufacturer's recommended procedures if more stringent than industry standards. The following is an outline of the triple evacuation method.
1. Pull initial vacuum on the line set testing for a leak. If it holds then pressure test with Nitrogen at 300 psi minimum.
  2. Pump system down, recharge with Nitrogen to 2 psi. Perform this step two times.
  3. Pump system down, re-pressurize with Nitrogen and then evacuate system to 500 microns. Hold for 30 minutes.
  4. Break vacuum with refrigerant and charge per manufacturer's directions.
- 3.4 HANGERS AND SUPPORTS
- A. General: Hangers, supports, and anchors are specified in Division 23 Sections. Provide according to ASME B31.5 and MSS SP-69.

- B. Adjustable steel clevis hangers or swivel loop hangers for individual horizontal runs less than 20 feet in length.
- C. Roller hangers and spring hangers for individual horizontal runs 100 feet or longer.
- D. Pipe rollers for multiple horizontal runs, 100 feet or longer supported by a trapeze.
- E. Spring hangers to support vertical runs.
- F. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.
  - 1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  - 5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 6. 2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 7. 2-1/2 Inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 8. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 9. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- G. Support vertical runs at each floor.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Basic pipe and tube joint construction is specified in Division 23 Sections.
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

### 3.6 VALVE INSTALLATIONS

- A. Install refrigerant valves according to manufacturer's written instructions.
- B. Provide liquid line solenoid valves for 7½-ton systems and larger, and where recommended by the HVAC equipment manufacturer.
  - 1. Install solenoid valves in horizontal lines with coil at top.
  - 2. Electrical wiring for solenoid valves is provided under Division 22 and specified in Division 26 Sections. Coordinate electrical requirements and connections.
- C. Provide thermal expansion valve (TXV) or electronic expansion valve (EEV) on all systems:
  - 1. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
  - 2. Size valves to provide full rated capacity of cooling coil serviced. Coordinate selection with evaporator coil and condensing unit.
  - 3. Install valves in accordance with equipment and valve manufacturer's instructions.

- D. Install pressure-regulating and relief valves as required by ASHRAE 15.

### 3.7 SPECIALTIES APPLICATION AND INSTALLATION

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install pressure relief valves on ASME receivers, and pipe to outdoors.
- C. Install filter-dryers in liquid line adjacent to receivers, coils and before each solenoid valve.
- D. Install receivers on systems 5 tons and larger, and on systems with long piping runs, sized to accommodate pump-down charge.

### 3.8 CONNECTIONS

- A. Electrical: Conform to applicable requirements of Division 26 Sections for electrical connections.

### 3.9 FIELD QUALITY CONTROL

- A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.
  - 1. Pressure test with nitrogen per accepted industry practices using soap bubbles or electronic leak detector. Test to no leakage.
- B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- C. Repair leaks using new materials; retest.

### 3.10 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements. Adjust hot gas bypass valve for proper unloading.

### 3.11 CLEANING

- A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

### 3.12 COMMISSIONING

- A. Charge system per industry accepted standards for systems utilizing R-410A, or manufacturer's recommended procedures if more stringent than industry standards. The following is an outline of the triple evacuation method.

1. Pull initial vacuum on the line set testing for a leak. If it holds then pressure test with Nitrogen at 300 psi minimum.
2. Pump system down, recharge with Nitrogen to 2 psi. Perform this step two times.
3. Pump system down, re-pressurize with Nitrogen and then evacuate system to 500 microns. Hold for 30 minutes.
4. Break vacuum with refrigerant and charge per manufacturer's directions.

**END OF SECTION 232300**

**SECTION 233113 - METAL DUCTWORK****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract apply to this Section.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 23 Section "Duct Accessories" for flexible duct materials, dampers, duct-mounted access panels and doors, turning vanes, duct silencers, fabric ducts, pre-insulated outdoor ductwork, and turning vanes.
  - 2. Division 23 Section "HVAC Insulation" for external duct and plenum insulation.
  - 3. Division 23 Section "Diffusers, Registers, Grilles and Louvers."
  - 4. Division 23 Section "Air Terminals," for constant-volume control boxes, variable-air-volume control boxes, and reheat boxes.
  - 5. Division 23 Section "Testing, Adjusting, and Balancing."

**1.2 SUMMARY**

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 4 inches to plus 10 inches water gage.

**1.3 DEFINITIONS**

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
  - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
  - 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

**1.4 SYSTEM PERFORMANCE REQUIREMENTS**

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

**1.5 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
  - 1. Duct Liner.
  - 2. Sealing Materials.
- C. Coordination drawings for ductwork installation in accordance with Division 23 Sections. In addition to the requirements specified, show the following:
  - 1. Coordination with ceiling suspension members.
  - 2. Spatial coordination with other systems installed in the same space with the duct systems.
  - 3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
  - 4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- D. Welding certificates, including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.
- E. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices.
- F. Maintenance data for volume control devices, fire dampers, and smoke dampers.

**1.6 QUALITY ASSURANCE**

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."
- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- C. NFPA Compliance: Comply with the following NFPA Standards:
  - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

- B. Store and handle sealant materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

**PART 2 - PRODUCTS****2.1 SHEET METAL MATERIALS**

- A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
- C. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- D. Stainless Steel: ASTM A 480, Type 316, sheet form, with No. 3 finish on exposed surface for ducts exposed to view; Type 304, sheet form, with No. 1 finish for concealed ducts.
- E. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish where ducts are exposed to view, and mill finish for concealed ducts.
- F. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

**2.2 DUCT LINER**

- A. General: Comply with NFPA Standard 90A.
- B. Materials: ASTM C 1071, Type II, with coated surface exposed to airstream to prevent erosion of glass fibers.
  - 1. Thickness: 1 inch.
  - 2. Density: 1-1/2 pounds.
  - 3. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 deg F.
  - 4. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C 411.
  - 5. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C 916.



6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
  - a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
  - b. Adhesive for Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

### 2.3 SEALING MATERIALS

- A. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for class 1 ducts.
- B. Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.
- C. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

### 2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, zinc plated steel, threaded rod.
  1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
  2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1995 Edition, for sheet steel width and gage and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
  1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
  2. For stainless steel ducts, provide stainless steel support materials.
  3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

**2.5 RECTANGULAR DUCT FABRICATION**

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
  - 1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
  - 2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
  - 3. Square throat, round heel elbows shall not be used.

**2.6 STATIC PRESSURE CLASSIFICATION**

- A. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
  - 1. Low Pressure Supply Ducts: 1-inch water gage.
  - 2. Spiral Medium Pressure Supply Ducts (VAV): 6-inches water gage.
  - 3. Return Ducts: 1-inch water gage, negative pressure.
  - 4. Low Pressure Exhaust Ducts: 1-inch water gage, negative pressure.
- B. Cross-breaking or Cross Beading: Cross-break or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

**2.7 RECTANGULAR DUCT FITTINGS**

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1995 Edition, Figures 2-1 through 2-10.

**2.8 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS**

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.

- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
  - 1. Fan discharge.
  - 2. Intervals of lined duct preceding unlined duct.
- H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

## 2.9 MEDIUM PRESSURE ROUND AND FLAT OVAL DUCT FABRICATION

- A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given size of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
- B. Round Ducts: Fabricate round supply ducts with spiral lock-seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.
- C. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lock-seams (without intermediate ribs) or with butt-welded longitudinal seams in gages listed in SMACNA "HVAC Duct Construction Standards," Table 3-4.
- D. Double-Wall (Acoustic) Ducts: Fabricate double-wall insulated ducts with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on double wall ducts are nominal inside dimensions.
  - 1. Thermal Conductivity: 0.27 Btu/sq.ft./deg F/inch thickness at 75 deg F mean temperature.
  - 2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation, and in gages specified above for single-wall duct.
  - 3. Insulation: Unless otherwise indicated, provide 1-inch-thick fiber-glass insulation. Provide insulation ends where internally insulated duct connects to single-wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.
  - 4. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gages listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated below is the "basic round diameter."
    - a. 3 to 8 inches: 28 gage with standard spiral construction.
    - b. 9 to 42 inches: 28 gage with single-rib spiral construction.

- c. 44 to 60 inches: 26 gage with single-rib spiral construction.
  - d. 62 to 88 inches: 22 gage with standard spiral construction.
5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

## 2.10 ROUND AND FLAT OVAL DUCT SUPPLY AND EXHAUST FITTINGS FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1995 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
  1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.
    - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
    - b. Round Mitered Elbows: Spot welded and bonded with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
      - 1) 3 to 26 inches: 24 gage.
      - 2) 27 to 36 inches: 22 gage.
      - 3) 37 to 50 inches: 20 gage.
      - 4) 52 to 60 inches: 18 gage.
      - 5) 62 to 84 inches: 16 gage.
    - c. Round Mitered Elbows: Spot welded and bonded with metal thickness listed below for pressure classes from 2 inches to 10 inches:
      - 1) 3 to 14 inches: 24 gage.
      - 2) 15 to 26 inches: 22 gage.
      - 3) 27 to 50 inches: 20 gage.
      - 4) 52 to 60 inches: 18 gage.
      - 5) 62 to 84 inches: 16 gage.
    - d. Flat Oval Mitered Elbows: Spot welded and bonded with the same metal thickness as longitudinal seam flat oval duct.
    - e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.

2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
  3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
  4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
  5. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.
  6. Round Gored Elbows Gages: Same as for non-elbow fittings specified above.
  7. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.
  8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gage.
- D. Double-Wall (Acoustic) Fittings: Fabricate double-wall insulated fittings with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.
1. Thermal Conductivity: 0.27 Btu/sq.ft./deg F/inch thickness at 75 deg F mean temperature.
  2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation. Gages for outer shell shall be same as for uninsulated fittings specified above.
  3. Insulation: Unless otherwise indicated, provide 1-inch-thick fiber-glass insulation. Provide insulation ends where internally insulated duct connects to single-wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.
  4. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gages listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
    - a. 3 to 34 inches: 24 gage.
    - b. 35 to 58 inches: 22 gage.
    - c. 60 to 88 inches: 20 gage.
  5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.
- E. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
1. Round Elbows 4 to 8 Inches: 2-piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.
  2. Round Elbows 9 to 26 Inches: Standing seam construction.
  3. Round Elbows 28 to 60 Inches: Standard gore construction, riveted and bonded.
  4. Other Fittings: Riveted and bonded joints.
  5. Couplings: Slip-joint construction with a minimum of a 2-inch insertion length.

**PART 3 - EXECUTION****3.1 DUCT INSTALLATION, GENERAL**

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Install ducts with the fewest possible joints.
- C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2-inches.
- M. Low pressure supply duct takeoffs shall be equivalent to Crown 306 or equal by Flexmaster or United McGill. Medium pressure takeoffs shall be conical type.
- N. Low pressure round duct runouts to supply diffusers may be "snap-lock" duct meeting the pressure classification.
- O. Exposed round duct shall be medium pressure spiral duct with mill-phosphatized treatment. Prime and paint - color selected by the Design Professional.

## 3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints as follows:
1. Conditioned Spaces:
    - a. Supply duct pressure classification 2-inches water gage and greater and exhaust ducts: All transverse joints and longitudinal seams.
    - b. Supply duct pressure classification less than 2-inches water gage and all return duct: All transverse joints and longitudinal seams.
    - c. Return and Exhaust Duct: All transverse joints and longitudinal seams.
  2. Unconditioned Spaces:
    - a. Supply duct pressure classification 2-inches water gage and greater: All transverse joints, longitudinal seams, and duct wall penetrations.
    - b. Supply duct pressure classification less than 2-inches water gage and all return duct: All transverse joints, and longitudinal seams.
    - c. Return and Exhaust Duct: All transverse joints.
  3. Outdoor Spaces:
    - a. All supply and return duct: All transverse joints, longitudinal seams, and duct wall penetrations.
    - b. Exhaust Duct: All transverse joints.
- B. Solvent based sealant shall only be used in applications where freezing may occur before sealant is cured. Water-based sealant shall be used in all other applications.
- C. Seal externally insulated ducts prior to insulation installation.
- D. All duct sealing shall be in accordance with ASHRAE standard 90.1.

## 3.3 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Chapter 5.
- B. Support horizontal ducts within 2-feet of each elbow and within 4-feet of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.
- E. Install concrete insert prior to placing concrete.
- F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

**3.4 CONNECTIONS**

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Duct Accessories."
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.
- D. Low pressure round supply duct takeoffs shall be equivalent to Crown 306 adjustable 45-degree takeoff. Other acceptable manufacturers include, but are not limited to, Flexmaster and United McGill.

**3.5 FIELD QUALITY CONTROL**

- A. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
- B. All ductwork shall be approved by the Design Professional prior to the application of external insulation. In the absence of such approval, smoke testing, pressure testing or other leakage testing of ductwork shall be required.
- C. Conduct duct pressure tests in the presence of the Design Professional after the testing has demonstrated that the duct system meets the stated leakage criteria.
- D. Determine leakage from entire medium pressure system or section of the system by relating leakage to the total system airflow capacity.
- E. The following systems shall be pressure tested in accordance with SMACNA's HVAC Air Duct Leakage Test Manual, and meet the stated criteria:
  - 1. Medium pressure supply ductwork: test at 4.5 inches water column static pressure, with a maximum allowable leakage rate of 0.5%.
  - 2. Low pressure supply ductwork: test at 1.0 inches water column static pressure, with a maximum leakage of 1%.
  - 3. Low pressure return and exhaust ductwork: test at 1.0 inches water column static pressure, with a maximum leakage of 1%.
- F. Do not pressurize systems above the maximum design operating pressure (static pressure classification.) Give 7 days' advanced notice for testing.
- G. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage. Integrity of ductwork shall be approved by the Design Professional prior to application of insulation.



**3.6 ADJUSTING AND CLEANING**

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

**END OF SECTION 233113**

**SECTION 233300 - DUCT ACCESSORIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:

1. Manual volume control dampers.
2. Fire and smoke dampers.
3. Turning vanes.
4. Duct-mounted access doors and panels.
5. Flexible connectors.
6. Flexible ducts.
7. Accessories hardware.

- B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 23 Section "Diffusers, Registers, Grilles and Louvers" for diffusers, registers, and grilles.
2. Division 23 Section "Air Terminals" for constant and variable air volume units.
3. Division 23 Section "Controls Systems Equipment" for HVAC control devices.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract.

- B. Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:

1. Manual volume control dampers.
2. Fire and smoke dampers.
3. Duct-mounted access panels and doors.
4. Flexible ducts.

- C. Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:

1. Special fittings and volume control damper installation (both manual and automatic) details.
2. Fire and smoke damper installations, including sleeves and duct-mounted access door and panel installations.

- D. Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static pressure loss, and dimensions and weights.
- E. Maintenance data for volume control devices, fire dampers, and smoke dampers

#### 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA Standards:
  - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
- B. U.L. Listing: Pre-insulated, outdoor ductwork shall meet U.L. 181, U.L. 723, and U.L. 94 Standards.

#### 1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
  - 1. Warranty Period, pre-insulated, outdoor ductwork: Manufacturer's standard but not less than 10 years for all system components.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect items from damage during shipping, storage and handling.
- B. Where possible, store products inside and protect from weather. Where necessary to store outside, store above grade and enclose with a vented waterproof wrapping.

### PART 2 - PRODUCTS

#### 2.1 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct

penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft.

- B. Standard Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications.
- C. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 16 gage, and with mitered and welded corners. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
  - 1. Roll-Formed Steel Blades: 16-gage galvanized steel.
  - 2. Blade Axles: Galvanized steel.
  - 3. Tie Bars and Brackets: Galvanized steel.
- D. Low-Leakage Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications. Leakage shall be less than 10 cfm at 3.0 inches differential static pressure.
  - 1. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 16 gage, and with mitered and welded corners. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
  - 2. Aluminum Frames: Hat-shaped, 0.063-inch-thick, 6063T extruded aluminum channels. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
  - 3. Extruded Aluminum Blades: 0.050-inch-thick 6063T extruded aluminum.
  - 4. Blade Seals: Neoprene.
  - 5. Blade Axles: Nonferrous.
  - 6. Tie Bars and Brackets: Aluminum.
- E. Jackshaft: 1-inch-diameter, galvanized-steel pipe or 1/2" square galvanized bar stock rotating within a pipe bearing assembly mounted on supports at each mullion and at each end of multiple damper assemblies. Provide appropriate length and number of mountings to connect linkage of each damper of a multiple damper assembly. Cut groove in the end of the shaft parallel with damper blades.
- F. Damper Control Hardware: Zinc-plated, die-cast core with a heavy-gage dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Provide center hole to suit damper operating rod size. Provide elevated platform for insulated duct mounting.

## 2.2 FIRE DAMPERS

- A. General: UL labeled according to UL Standard 555 "Standard for Fire Dampers." Ratings shall be for dynamic system operation at 350° temperature.
  - 1. Dampers used in low pressure systems shall be rated for 2000 fpm velocity and 4" wg pressure.
  - 2. Dampers used in medium pressure systems (VAV supply and medium pressure exhaust) shall be rated for 3000 fpm and 8" wg pressure.

- B. Fire Rating: 1-1/2 or 3 hours, as indicated by wall ratings on Architectural Plans.
- C. Frame: Type B (blades outside airstream); fabricated with roll-formed, 21-gage, galvanized-steel; with mitered and interlocking corners. Furnish multi-blade dampers where required by code.
- D. Mounting Sleeve: Factory-installed or field-installed galvanized steel.
  - 1. Minimum Thickness: 0.056-inch (16-gage) or 0.138-inch (10-gage) thick as indicated, and length to suit application.
  - 2. Exception: Furnish narrow frame damper without sleeve in applications where damper is mounted in rated partition behind supply/return register.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 21-gage galvanized steel. In place of interlocking blades, provide full-length, 21-gage, galvanized-steel blade connectors.
- G. Fusible Link: Replaceable, 165 deg F rated.

### 2.3 SMOKE AND FIRE/SMOKE DAMPERS

- A. General: UL-labeled according to UL Standard 555S, "Standard for Leakage Rated Dampers for Use in Smoke Control Systems." Combination fire and smoke dampers shall also be UL-labeled for 1-1/2-hour rating according to UL Standard 555 "Standard for Fire Dampers with a Class II leakage rating." Dampers shall be tested at a 350E air temperature.
  - 1. Dampers used in low pressure systems shall be rated for 2000 fpm velocity and 4" wg pressure.
  - 2. Dampers used in medium pressure systems (VAV supply and medium pressure exhaust) shall be rated for 3000 fpm and 8" wg pressure.
- B. Fusible Link: Replaceable, 165 deg F rated as indicated (fire/smoke dampers only.)
- C. Frame and Blades: 16-gage galvanized steel.
- D. Mounting Sleeve: Factory-installed, 18-gage galvanized steel, length to suit wall or floor application.
- E. Pneumatic (electric) actuator with end switch. All actuators shall be factory mounted outside of the airstream. Furnish damper end switch for control interlocks

### 2.8 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center and set into side strips suitable for mounting in ducts.

- C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fiber glass fill.

## 2.9 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Provide construction and airtightness suitable for duct pressure class.
- B. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of locks as indicated for duct pressure class. Provide vision panel where indicated. Provide cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.
- E. Insulation: 1-inch-thick fiber glass or polystyrene foam board.

## 2.10 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL Standard 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gage, galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 3<sup>rd</sup> Edition, Figure 7-8.
- C. Extra-Wide Metal-Edged Connectors: Factory-fabricated with a strip of fabric 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gage, galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.
- D. Transverse Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 4-3/8-inch-wide, 24-gage, galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.
- E. Conventional, Indoor System Flexible Connectors Fabric: Glass fabric double coated with polychloroprene.
  - 1. Minimum Weight: 26 oz./sq. yd.
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
- F. Conventional, Outdoor System Flexible Connectors Fabric: Glass fabric double coated with Du Pont's HYPALON or other synthetic-rubber weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
  - 1. Minimum Weight: 26 oz./sq. yd.
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.

**2.11 FLEXIBLE DUCTS**

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts - Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.
- C. Flexible Ducts - Uninsulated: Corrugated aluminum.
- D. Flexible Ducts - Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch-thick, glass fiber insulation around a continuous inner liner.
  - 1. Reinforcement: Steel-wire helix encapsulated in the inner liner.
  - 2. Outer Jacket: Glass-reinforced, silver mylar.
  - 3. Inner Liner: Polyethylene film.
  - 4. Pressure Rating: 10-inches wg, positive.
  - 5. R value = 6.0
- E. Woven Polypropylene Hanging Strap:
  - 1. Hanging straps shall be manufactured of woven polypropylene 1<sup>3</sup>/<sub>4</sub>" wide and having a minimum 400-pound tensile strength.
  - 2. Strap material shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50.
  - 3. Strap material shall be manufactured for flexible HVAC duct support and shall be installed in accordance with the manufacturer's instructions and SMACNA standards.
  - 4. Straps shall be used on flexible ducts only, and not on rigid ductwork.

**2.12 ACCESSORIES HARDWARE**

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pitot tube and other testing instruments and provide in length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless steel band with cadmium-plated hex screw to tighten band with a worm-gear action. Provide in sizes from 3 to 18 inches to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline and grease.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

**3.2 INSTALLATION**

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.
- B. Install volume control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to the manufacturer's UL-approved printed instructions.
- E. Install fusible links in fire dampers.
- F. Label access doors according to Division 23 Section "Mechanical Identification."

**3.3 ADJUSTING**

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

**END OF SECTION 233300**



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**SECTION 233423 - POWER AND GRAVITY VENTILATORS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Centrifugal roof ventilators.
  - 2. Ceiling-mounted ventilators.
  - 3. In-line centrifugal fans.
  - 4. Fly fans.
  - 5. Roof-mounted gravity ventilators.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Project Altitude: Base air ratings on sea-level conditions.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
  - 1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
  - 2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

**1.4 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound power ratings.
  - 3. Motor ratings and electrical characteristics plus motor and electrical accessories.
  - 4. Material gages and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.

- C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- D. Coordination Drawings, according to Division 23 sections for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
  - 1. Roof framing and support members relative to duct penetrations.
  - 2. Ceiling suspension assembly members.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- E. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
- F. Maintenance data for power ventilators to include in the operation and maintenance manual.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- E. UL Standard: Provide power ventilators that comply with UL 705.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

#### 1.7 COORDINATION AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.

- B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.

## 1.8 EXTRA MATERIALS

- A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme
  - 2. Barry Blower
  - 3. Berner
  - 4. Broan Mfg. Co., Inc.
  - 5. Carnes Co.
  - 6. Central Blower Co.
  - 7. Cincinnati Fan & Ventilator Co.
  - 8. Cook (Loren) Co.
  - 9. Essick Air Products, Breidert.
  - 10. Greenheck Fan Corp.
  - 11. Hartzell
  - 12. ILG Industries, Inc.
  - 13. Jenn Industries Inc.
  - 14. Lau Division Philips Industries, Inc.
  - 15. Mars
  - 16. Penn
  - 17. Twin City

### 2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
  - 1. Up-blast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

- D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
  2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  4. Fan and motor isolated from exhaust air stream.
- E. Accessories: The following items are required as indicated:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
  2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
  3. Bird Screens: Removable 1/2-inch mesh, aluminum or brass wire.
  4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  5. Roof Curbs: Galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch wood nailer. Size as required to suit roof opening and fan base.
    - a. Over-all Height: 12 inches above roof surface.
  6. Curb Adapters: Galvanized steel; mitered and welded corners. Size to fit existing curb base to new unit.

### 2.3 CEILING-MOUNTED VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall, or for concealed in-line applications.
- B. Housing: Galvanized steel.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille (Ceiling Mounted): Aluminum grille with baked enamel finish. Furnish in-line configuration where indicated.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in. (Integral disconnect device.)
- F. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
- G. Accessories: Manufacturer's standard roof jack or wall cap, and transition fittings where indicated on the drawings.

**2.4 IN-LINE CENTRIFUGAL FANS**

- A. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.
- B. Housing: Galvanized steel panel construction with inlet and outlet flanges; and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor encased in housing out of air stream, factory wired to disconnect located on outside of fan housing.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories: The following accessories are required as indicated:
  - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
  - 2. Companion Flanges: For inlet and outlet duct connections.
  - 3. Fan Guards: Expanded metal in removable frame. Provide belt guards for units with external motors.

**2.5 FLY FAN**

- A. Fan shall have single speed motor and door switch. Fan shall be full width of the door over which it is installed. Fan shall be NSF-37 listed.

**2.6 MOTORS**

- A. Refer to Division 23 sections for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B. Furnish premium efficiency motors for all above 1 horsepower.
- C. Enclosure Type: The following features are required as indicated:
  - 1. Open drip-proof motors where satisfactorily housed or remotely located during operation.
  - 2. Guarded drip-proof motors where exposed to contact by employees or building occupants.

**2.7 ROOF MOUNTED GRAVITY VENTILATORS**

- A. Ventilator shall be stationary unit of type indicated on the drawings, all aluminum construction with curb base and aluminum bird-screen. Ventilator shall be provided with matching prefabricated roof curb same as specified for roof exhaust fans. Secure ventilator to roof curb with cadmium-plated steel screws, minimum of two on each side.

**2.8 FACTORY FINISHES**

- A. Sheet Metal Parts: Prime coat before final assembly.
- B. Exterior Surfaces: Baked-enamel finish coat after assembly.
- C. Aluminum Parts: No finish required.

**2.9 SOURCE QUALITY CONTROL**

- A. Testing Requirements: The following factory tests are required as indicated:
  - 1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
  - 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install power ventilators according to manufacturer's written instructions.
- B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Division 23 Sections.
  - 1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. Furnish a minimum of one screw per side of the curb.
  - 2. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
  - 3. Ceiling Units: Suspend units from structure using steel wire or metal straps.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23.

**3.3 CONNECTIONS**

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Electrical: Conform to applicable requirements in Division 26 Sections.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

**3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

**3.5 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

**3.6 CLEANING**

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

**3.7 COMMISSIONING**

- A. Final Checks before Startup: Perform the following operations and checks before startup:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
  - 3. Perform cleaning and adjusting specified in this Section.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.



6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
  7. Disable automatic temperature-control operators.
- B. Starting procedures for fans are as follows:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
  2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals.
- C. Schedule training with Owner, through the Design Professional, with at least 7 days' advance notice.
- D. Demonstrate operation of power ventilators.

**END OF SECTION 233423**

**SECTION 233713 - DIFFUSERS, REGISTERS, GRILLES AND LOUVERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes ceiling- and wall-mounted diffusers, registers, grilles and louvers.

**1.3 DEFINITIONS**

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.
- D. Louver: Exterior wall air device which resists the penetration of rain.

**1.4 SUBMITTALS**

- A. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
  - 3. Schedule of diffusers, registers, grilles and louvers indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
  - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

**1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, grilles and louvers and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered.
- B. NFPA Compliance: Install diffusers, registers, grilles and louvers according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

**PART 2 - PRODUCTS****2.1 MANUFACTURED UNITS**

- A. Acceptable manufacturers shall be:
  - 1. Anemostat Products
  - 2. Arrow
  - 3. Carnes Co.
  - 4. Greenheck
  - 5. Hart and Cooley
  - 6. Tuttle and Bailey
  - 7. Krueger
  - 8. J&J
  - 9. Nailor
  - 10. Titus
  - 11. Metal\*Aire
  - 12. Vent Products
  - 13. Price
  - 14. Dowco
  - 15. Ruskin
- B. All louver face ceiling diffusers shall have four cones and removable cores.
- C. All exterior louvers shall be 6-inches deep.

**2.2 SOURCE QUALITY CONTROL**

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas where diffusers, registers, grilles and louvers are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install diffusers, registers, grilles and louvers level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where Design Professional features or other items conflict with installation, notify Design Professional for a determination of final location.
- C. Install diffusers, registers, grilles and louvers with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.3 ADJUSTING**

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

**3.4 CLEANING**

- A. After installation of diffusers, registers, grilles and louvers, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

**END OF SECTION 233713**

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**SECTION 234000 – BIPOLAR IONIZATION AIR PURIFICATION SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This section describes the design, performance and installation of a bipolar ionization air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

**1.3 REFERENCED CODES & STANDARDS**

- A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.
1. ASHRAE Standards 62 & 52
  2. National Electric Code NFPA 70
  3. UL 867

**1.4 QUALITY ASSURANCE**

- A. The bipolar ionization air purification system shall be a product of an established manufacturer in the USA.
- B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
- C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.
- D. Projects designed using ASHRAE Standard 62.1 *IAQ Procedure* shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 or later version to validate acceptable indoor air quality at the quantity of outside air scheduled.
- E. The bipolar ionization system shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007.

- F. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.001 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the output of the bipolar ionization unit shall be no more than 0.0012 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.
- G. Electrical Component Standard: Provide components that comply with NFPA 70 "National Electrical Code."
- H. NEMA Compliance: Provide electrical components required as part of filter assembly that are listed and labeled by UL and comply with applicable NEMA standards.
- I. Listing and Labeling: Provide electrical components that are listed and labeled.
  - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- J. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B.

#### 1.5 SUBMITTALS

- A. Submit manufacturer's technical product data for ion generators including:
  - 1. Schedule of bipolar ionization units indicating model number and quantity of each type required for each application.
  - 2. Submittal sheet for each type of bipolar ionization unit and accessories furnished; indicating construction, dimensions, electrical data, and mounting details.
  - 3. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 or later version to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with reduced outside air).
  - 4. Product drawings detailing all physical, electrical and control requirements.
- B. Operating & Maintenance Data: Submit O&M data and recommended spare parts list.

#### 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of products shall be in factory fabricated shipping cartons. Identify on outside of carton the type of product contained within. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage.

#### 1.7 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerisa
  2. Air Oasis
  3. Bioclimatic
  4. Global Plasma Solutions (GPS)
  5. Plasma Air

**2.2 GENERAL**

- A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit scheduled.
- B. All other suppliers of comparable products requesting prior approval shall:
1. Submit a request for prior approval at least 15 days prior to bid date. Requests received after that time will not be considered.
  2. In addition, as part of the prior approval request, Bipolar Ionization manufacturers must submit their IAQ calculations that prove conformance to ASHRAE Standard 62.1-2007 or later version with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third-party validation study performed on a previous installation of the same application shall also be included.
  3. Submit independent test data from ETL or UL on the ozone chamber test.
  4. Submit at least two other end user references in the same application with contact phone number, email, equipment used and application at that facility. Manufacturers not having the above references in similar applications using the same equipment models as proposed on the current project shall not be acceptable.

**2.3 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA**

- A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.
- B. The bipolar ionization system shall be capable of:
1. Effectively killing microorganisms downstream of the bipolar ionization equipment (e.g., mold, bacteria, virus).
  2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
  3. Reducing space static charges.
  4. Reducing space particle counts.



- C. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Uni-polar (or single pole) ion devices shall not be acceptable.
1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
  2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions to the air purification system.
- E. Ionization Equipment Requirements:
1. Electrode Specifications (bipolar ionization):
    - a. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time and corrosion.
    - b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
    - c. Ionization output from each electrode shall be a minimum of 5-million ions/cc when tested at 2" from the ion generator.
    - d. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum.
  2. Units Mounted in Airstream:
    - a. Bipolar ionization units for fan-mounted and duct-mounted applications shall be brush type needlepoint units.
    - b. Each bipolar ionization unit shall be rated for the airflow it will be treating.
    - c. The bipolar unit housing is made of acrylonitrile butadiene styrene, contains an LED ionization output-indicator, and an in-line 1 Amp fuse
    - d. The unit shall contain two (2) mounting feet such that when mounted, the needlepoint brushes are oriented perpendicular to the flow.
    - e. Provide self-cleaning accessories to periodically clean electrodes.
  3. Certifications
    - a. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners.
    - b. The operation of the electrodes or bipolar ionization units shall conform to UL 867 with respect to ozone generation.
- F. Electrical Requirements:
1. Ion generators shall directly accept voltage provided from the voltage provided from the fan coil unit or air handling unit served. Ion generators requiring a loose transformer or power supply will not be accepted.

2. Wiring, conduit and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

**PART 3 - EXECUTION****3.1 GENERAL**

- A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

**3.2 ASSEMBLY & INSTALLATION: PLASMA GENERATOR WITH BI-POLAR IONIZATION**

- A. All equipment shall be assembled and installed with a high level of workmanship to the satisfaction of the Owner and Design Professional.
- B. Any material damaged by handling, water or moisture shall be replaced by the mechanical contractor at no cost to the owner.
- C. All equipment shall be protected from damage on a daily basis throughout construction.
- D. Install electrical devices in accordance with manufacturer's instructions and with electrical divisions of the specifications.

**3.3 COMMISSIONING & TRAINING**

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

**END OF SECTION 234000**

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**SECTION 238119 - ROOFTOP UNITS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes rooftop heating and cooling units.
- B. Related Sections include the following:
  - 1. Other Division 23 sections for manufactured isolation bases.
  - 2. Other Division 23 sections for temperature-control devices, and control wiring and control devices connected to units.
  - 3. Other Division 23 sections for starters and drives.

**1.3 SUBMITTALS**

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
- D. Maintenance Data: For equipment to include in the maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

**1.4 QUALITY ASSURANCE**

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

- B. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- C. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units as factory-assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

#### 1.6 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction.

#### 1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
  - 1. Standard warranty for future unit shall be minimum of 1 year parts and labor. Manufacturer shall replace any defects during this time at no added cost to the Owner.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
  - 1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years (parts only) after date of Material Completion.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Filters: Three (3) sets of filters for each unit.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Rooftop Units, 6 Tons and Smaller:
    - a. Carrier Corp.; Carrier Air Conditioning Div.
    - b. Trane Company (The); North American Commercial Group.
    - c. Lennox
  2. Rooftop Units, 7-1/2 to 20 Tons:
    - a. Carrier Corp.; Carrier Air Conditioning Div.
    - b. Trane Company (The); North American Commercial Group.
    - c. Lennox

**2.2 ROOFTOP UNITS SMALLER THAN 6 TONS**

- A. Description: Factory assembled and tested; designed for roof or slab installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.
- B. Casing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch-thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs. Furnish condenser coil guards.
- C. Evaporator Fans: Forward curved, centrifugal, directly driven with permanently lubricated motor bearings.
- D. Condenser Fans: Propeller type, directly driven with permanently lubricated motor bearings.
- E. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in galvanized steel casing with equalizing-type vertical distributor or all-aluminum, fully brazed construction with flat, micro-channel tubes. Furnish stainless steel drain in accordance with ASHRAE Standard 62.
- F. Compressors: Hermetic with integral vibration isolators and crankcase heaters. Furnish reversing valve for heat pump units.
- G. Electric Heat: Manufacturer's standard construction, factory wired for single-point wiring connection, with overcurrent and overheat protection devices.
- H. Furnish hot gas reheat coil and control valve capable of providing dehumidification function where indicated on schedule.

- I. Economizer Control: Return- and outside-air dampers, outside-air filter, fully modulating electronic-control system with adjustable mixed-air thermostat and automatic changeover.
- J. Low Ambient Control: Head-pressure control, designed to operate at temperatures as low as 30 deg F.
- K. Microprocessor controls: Provide with terminal strip for control via the FMS. Provide all optional safeties including refrigerant pressure alarms.
- L. Thermostat: DDC thermostat as specified in other Division 23 sections.
- M. Convenience Outlet:
  - 1. Optional factory-installed, unpowered, ground-fault protected convenience outlet shall be internally mounted with an externally accessible 115-V 2-plug female receptacle with hinged cover.
  - 2. Voltage shall be field-applied as specified in Division 26.
- N. Electrical Disconnect:
  - 1. Shall be factory-installed, internally mounted, NEC and UL approved. Disconnect shall provide unit power shutoff.
  - 2. Shall be accessible from outside the unit and shall provide power off lockout capability.

### 2.3 ROOFTOP UNITS, 7-1/2 TO 20 TONS

- A. Description: Factory assembled and tested; designed for roof or slab installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.
- B. Casing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch-thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs. Furnish condenser coil guards.
- C. Evaporator Fans: Forward curved, centrifugal, belt driven with adjustable sheaves or direct-drive fans; and with permanently lubricated motor bearings.
- D. Exhaust/Relief Fans: Forward-curved, centrifugal or propeller type, directly driven with permanently lubricated motor bearings.
- E. Condenser Fans: Propeller type, directly driven with permanently lubricated motor bearings.
- F. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in galvanized steel casing with equalizing-type vertical distributor or all-aluminum, fully brazed construction with flat, micro-channel tube.

- G. Compressors: Serviceable, semi-hermetic, or fully hermetic compressors with integral vibration isolators and crankcase heaters.
    - 1. Safety Controls: Manual-reset type for low pressure, high pressure, and compressor motor overload protection.
    - 2. Hot-Gas Bypass: Factory-installed valve.
    - 3. Timed-Off Control: Automatic-reset control holds compressor off for 5-minutes after last run.
  - H. Electric Heat: Manufacturer's standard construction, electric resistance, factory wired for single-point wiring connection, with overcurrent and overheat protection devices.
  - I. Furnish hot gas reheat coil and control valve capable of providing dehumidification function where indicated on schedule.
  - J. Economizer Control: Return- and outside-air dampers, outside-air filter, fully modulating electronic-control system with adjustable mixed-air thermostat and automatic changeover through adjustable enthalpy-control device.
  - K. Low Ambient Control: Head-pressure control, designed to operate at temperatures as low as 20 deg F.
  - L. Thermostat: DDC thermostat as specified in other Division 23 sections.
  - M. Operating Controls: Factory-installed microprocessor controls with terminal strip for mode control by the FMS controller.
    - 1. Control Outputs: 2-stage heating, 2-stage cooling; and automatic or continuous fan operation and economizer damper operation.
    - 2. Comparative enthalpy economizer controller with mixed air temperature and humidity sensors.
  - N. Convenience Outlet:
    - 1. Optional factory-installed, unpowered, ground-fault protected convenience outlet shall be internally mounted with an externally accessible 115-V 2-plug female receptacle with hinged cover.
    - 2. Voltage shall be field-applied as specified in Division 26.
  - O. Electrical Disconnect:
    - 1. Shall be factory-installed, internally mounted, NEC and UL approved. Disconnect shall provide unit power shutoff.
    - 2. Shall be accessible from outside the unit and shall provide power off lockout capability.
- 2.4 ROOF CURBS
- A. Manufacturer's standard, insulated with corrosion-protection coating, gasketing, factory-installed wood nailer, according to NRCA standards.



1. Curb Height: Minimum 8" above roof surface.
2. Isolation Curb: Rigid upper and lower steel structure with vibration isolation springs and vertical and horizontal restraints; with elastomeric waterproof membrane. 1-inch static deflection. See other Division 23 sections.

## 2.5 MOTORS

- A. Refer to other Division 23 sections for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- C. Enclosure Type: Open, drip-proof.

## 2.6 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate capacity according to ARI 210/240, "Unitary Air-Conditioning and Air Source Heat Pump Equipment."
- B. Verification of Performance: Rate capacity according to ARI 360, "Commercial and Industrial Unitary Air-Conditioning Equipment."
  1. Sound Power Level Ratings: Comply with ARI 270, "Standard for Sound Rating of Outdoor Unitary Equipment."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roof for compliance with requirements for conditions affecting installation and performance of rooftop units. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances.
- C. Curb Support: Install roof curb on roof structure, level, according to NRCA's written installation instructions. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing with roof construction.

**3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping to allow service and maintenance.
  - 2. Condensate drain piping: Route condensate drainage in Type L copper with soldered fittings.
- B. Duct installation requirements are specified in other Division 23 sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination in roof mounting frames. Where indicated, terminate return-air duct through roof structure and insulate space between roof and bottom of unit.
- C. Electrical: Conform to applicable requirements in Division 26 Sections.
- D. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

**3.4 COMMISSIONING**

- A. Verify that installation is as indicated and specified.
- B. Complete manufacturer's installation and startup checks and perform the following:
  - 1. Level unit on housekeeping base, and flash curbs to unit and to roof.
  - 2. Inspect for visible damage to unit casing.
  - 3. Inspect for visible damage to furnace combustion chamber.
  - 4. Inspect for visible damage to compressor, air-cooled condenser coil, and fans.
  - 5. Verify that clearances have been provided for servicing.
  - 6. Check that labels are clearly visible.
  - 7. Clean furnace flue and condenser and inspect for construction debris.
  - 8. Verify that controls are connected and operable.
  - 9. Remove shipping bolts, blocks, and tie-down straps.
  - 10. Verify that filters are installed.
  - 11. Adjust vibration isolators.
  - 12. Connect and purge gas line.
  - 13. Check acoustic insulation.
  - 14. Check operation of barometric dampers.
- C. Lubricate bearings on fan.
- D. Check fan-wheel rotation for correct direction without vibration and binding.
- E. Adjust fan belts to proper alignment and tension.

- F. Start unit according to manufacturer's written instructions.
  - 1. Perform starting of refrigeration in summer only.
  - 2. Complete startup sheets and attach copy with Contractor's startup report.
- G. Check and record performance of interlocks and protection devices; verify sequences.
- H. Operate unit for an initial period as recommended or required by manufacturer.
- I. Calibrate thermostats.
- J. Adjust and check high-temperature limits.
- K. Check internal isolators.
- L. Check outside-air damper for proper stroke and interlock with return-air dampers.
- M. Check controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
- N. Start refrigeration and measure and record the following:
  - 1. Coil leaving-air, dry- and wet-bulb temperatures.
  - 2. Coil entering-air, dry- and wet-bulb temperatures.
  - 3. Outside-air, dry-bulb temperature.
  - 4. Air-cooled-condenser, discharge-air, dry-bulb temperature.
- O. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - 1. Supply-air volume.
  - 2. Return-air volume.
  - 3. Relief-air volume.
  - 4. Outside-air intake volume.
- P. Simulate maximum cooling demand and check the following:
  - 1. Compressor refrigerant suction and hot-gas pressures.
  - 2. Short circuiting air through condenser or from condenser to outside-air intake.
- Q. Verify operation of remote panel, including pilot-light operation and failure modes. Check the following:
  - 1. Warm-up for morning cycle.
  - 2. Free-cooling mode, outside-air changeover.
  - 3. Alarms.
- R. After starting and performance testing, change filters, vacuum heat exchanger and cooling and condenser coils, lubricate bearings, adjust belt tension, and check operation of power vents.

**3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  2. Review data in the maintenance manuals.
  3. Schedule training with Owner, through the Design Professional, with at least 7 days' advance notice.

**END OF SECTION 238119**

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**SECTION 238126 - SPLIT SYSTEM HEAT PUMPS AND AIR CONDITIONERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

**1.2 SUMMARY**

- A. This Section includes split system heat pump units and related components.

**1.3 SUBMITTALS**

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
  - 2. Refrigerant piping schematics showing sizes and accessories.
- C. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
- D. Maintenance Data: For equipment to include in the maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

**1.4 QUALITY ASSURANCE**

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

- D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

- 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

- E. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver indoor and outdoor units as factory-assembled units with protective crating and covering.

- B. Coordinate delivery of units in sufficient time to allow movement into building.

- C. Handle units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

#### 1.6 COORDINATION

- A. Coordinate installation of concrete pads and equipment supports

#### 1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

- 1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Material Completion.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

- 1. Filters: Three sets of filters for each unit.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductless Split Systems:
    - a. Carrier Corp.
    - b. Daikin
    - c. Gree Comfort
    - d. LG
    - e. Mitsubishi
    - f. Samsung
    - g. Sanyo
    - h. Trane

**2.2 DUCTLESS SPLIT SYSTEMS**

- A. Provide a split system heat pump and air conditioning units utilizing outdoor condenser and indoor evaporator connected by copper refrigerant tubing with flare type fittings. Outdoor unit shall contain sufficient R-410a to charge complete system. The condenser shall be equipped with an inverter-driven compressor and external brass service valves and charging port. Indoor unit shall be equipped with electric resistance back-up heater (where indicated.) The outdoor condenser shall have a capillary tube metering device located internally. Evaporator and condenser coils shall be constructed with aluminum fins mechanically bonded to copper tubes. The system shall bear the AHRI Certification symbol.
- B. Indoor unit shall be mounted as indicated on the Drawings. Controls shall be integral type IC thermostat with settings for multiple speeds and automatic position, 12-hour timer with ON/OFF settings, night set-back and energy saver position. Furnish hard-wired remote-control panel. Cooling and heating capacities and electrical characteristics shall be as shown on the Drawings. Supplemental electric resistance heat shall be provided where indicated.
- C. Provide disconnect device for indoor unit when power is supplied by outdoor unit. Furnish low ambient controls and condenser coil guards unless indicated otherwise.
- D. Where indicated on the drawings, provide condensate drainage pump with reservoir mounted below wall-hung indoor cassette units. Pump shall be mounted in a factory-made reservoir enclosure and shall be powered from the indoor unit circuit. Pump shall be self-priming. Pump shall be equivalent to the Blue Diamond Microblue with fascia kit, Rector seal Mini White, or Aspen Mini Blanc with opaque reservoirs.



**2.3 REFRIGERANT PIPE SIZE**

- A. Pipe sizes shown on the drawings are for estimating purposes only. Final pipe sizes shall be selected by the manufacturer and shall be included in the submittal data. Accessories (larger crankcase heaters, liquid line solenoid valve, oversize suction accumulators, wind baffles, etc.) required or recommended by the equipment manufacturer shall be provided at no additional cost.

**2.4 EMERGENCY DRAIN PAN**

- A. Provide 22-gauge galvanized emergency drain pan under all air handling units having water or drain connections. Drain pan shall extend 6" beyond unit on all sides, shall have 2" high hemmed sides. All seams and joints shall be soldered liquid tight.
- B. Furnish float switch in the emergency drain pan which de-energize the associated HVAC system when moisture is present.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine installation locations for compliance with requirements for conditions affecting installation and performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install units according to manufacturer's written instructions.
- B. Furnish float switch for unit shutdown interlock.

**3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping to allow service and maintenance.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. Furnish flexible connections at all unit connections.
- C. Electrical: Conform to applicable requirements in Division 26 Sections.

- D. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 COMMISSIONING

- A. Verify that installation is as indicated and specified.
- B. Complete manufacturer's installation and startup checks and perform the following:
  - 1. Level unit on support structure.
  - 2. Inspect for visible damage to unit casing.
  - 3. Inspect for visible damage to compressor, air-cooled condenser coil, and fans.
  - 4. Verify that clearances have been provided for servicing.
  - 5. Check that labels are clearly visible.
  - 6. Verify that controls are connected and operable.
  - 7. Remove shipping bolts, blocks, and tie-down straps.
  - 8. Verify that filters are installed.
  - 9. Adjust vibration isolators.
  - 10. Check acoustic insulation.
- C. Lubricate bearings on fan.
- D. Check fan-wheel rotation for correct direction without vibration and binding.
- E. Adjust fan belts to proper alignment and tension.
- F. Start unit according to manufacturer's written instructions.
  - 1. Perform starting of refrigeration in summer only.
  - 2. Complete startup sheets and attach copy with Contractor's startup report.
- G. Check and record performance of interlocks and protection devices; verify sequences.
- H. Operate unit for an initial period as recommended or required by manufacturer.
- I. Calibrate thermostats.
- J. Check internal isolators.
- K. Check controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.
- L. Simulate maximum cooling demand and check the following:
  - 1. Compressor refrigerant suction and hot-gas pressures.
  - 2. Short circuiting air through condenser or from condenser to outside-air intake.

- M. After starting and performance testing, change filters, vacuum heat exchanger and cooling and condenser coils, lubricate bearings and adjust belt tension.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
  - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  - 2. Review data in the maintenance manuals.
  - 3. Schedule training with Owner, through the Design Professional, with at least 7 days' advance notice.
  - 4. Provide letter from factory service representative stating that equipment is installed and operating as per manufacturer's recommendations.

**END OF SECTION 238126**

**SECTION 260000 - GENERAL**

## 1.01 CONTRACT DOCUMENTS:

- A. All work of Section 26 shall comply with the requirements of:
1. General Conditions
  2. Supplementary General Conditions
  3. General Requirements
  4. Specifications
  5. Drawings
  6. Modifications incorporated in the documents before their execution.

## 1.02 WORK INCLUDED

- A. This Division of the specifications (260000) covers the complete interior and exterior electrical system for all work shown on the drawings as specified herein providing all material, labor and equipment required for the installation of the electrical systems complete and in operating condition.
- B. Include in the electrical work all the necessary supervision and the issuing of all coordinating information to any other trades who are supplying work to accommodate the electrical installations.

## 1.03 DRAWINGS

- A. The drawings for electrical work utilize symbols and schematic diagrams which have no dimensional significance. The work shall therefore, be installed to fulfill the diagrammatic intent expressed on the electrical drawings.
- B. Review architectural drawings for door swings, cabinets, counters, moldings and built-in equipment, conditions indicated on architectural drawings shall govern. Prior to rough-in of receptacles and systems outlets, refer to architectural casework drawings for rough-in coordination.
- C. Coordinate electrical work with the architectural details, floor plans, elevations, structural and mechanical drawings. Provide fittings, junction boxes and accessories to meet conditions.
- D. Do not scale drawings. Dimensions for layout of equipment, or spaces shall be obtained from architectural, structural or mechanical drawings unless specifically indicated on the electrical drawings.
- E. Discrepancies shown on different drawings, between drawings and specifications or between drawings and field conditions shall be promptly brought to the attention of the Architect.

- F. Provide as used on the drawings and in the specifications shall mean, furnish, install, connect, adjust and test.
- G. The drawings and specifications are complimentary and any work or material shown in one and omitted in the other, or described in the one and not shown in the other, or which may be implied by both or either, shall be furnished as though shown on both, in order to give a complete and first class installation.

**1.04 SITE INVESTIGATION**

- A. Potential Contractors shall visit the project site prior to bid date to satisfy themselves as to the existing conditions and distances which may effect the cost of the project. Where work under this project requires extension, relocation, re-connecting or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition, with the exception of the work under this contract, before the completion of this project.

**1.05 SHOP DRAWINGS**

- A. Submit for approval by the Architect all materials and equipment to be incorporated in the electrical work.
- B. Submit only shop drawings which comply with the contract documents. Shop drawings shall be checked and corrected by the Contractor before they are submitted to the Architect. Shop drawings that are not corrected by the Contractor shall be returned for correction without detailed notations by the Architect as to the necessary corrections.
- C. Mark each individual submittal item to show specification section which pertains to the item.
- D. Submit information as required under SUBMITTALS, for each of the individual electrical sections of the specifications.
- E. Data submitted shall contain all information required to indicate compliance with equipment specified.
- F. Submit field information drawings to explain fully all procedures involved in erecting, mounting and connecting all items of equipment which differ from that specified.
- G. When Shop Drawings are reviewed, some errors may be detected but others may be overlooked. This does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Drawings and Specifications shall be followed and are not waived or superseded in any way by the Shop Drawing review.

- 1.06 RECORD DRAWINGS:
- A. One complete set of electrical drawings shall be reserved for as-built drawings. Any approved deviation from the contract drawings shall be recorded on these drawings. Drawings shall be checked monthly for completeness.
  - B. Completed as-built drawings shall be presented to the Architect prior to final inspection.
- 1.07 MAINTENANCE AND OPERATING INSTRUCTIONS:
- A. Provide at the time of final inspection three sets of maintenance and operating instruction for:
    - 1. Lighting and Power Panelboards
    - 2. Fuses
    - 3. Floor Boxes
    - 4. Wiring Devices
    - 5. Lighting Fixtures and Lamps
    - 6. Disconnect Switches
    - 7. Transformers
    - 8. Fire Alarm System
    - 9. Lighting Control System
    - 10. Intrusion Alarm System
    - 11. Surge Protection System
  - B. Furnish a qualified and accredited factory trained technician to train personnel designated by the Owner in the proper operation and maintenance of specialized equipment.
  - C. The issuing of operating instructions shall include the submission of the name, address, and telephone number of the manufacturer's representative and service company for each item of equipment so that service and spare parts can be readily obtained.
- 1.08 CODES AND PERMITS:
- A. All electrical work shall meet or exceed the latest requirements of the following codes and/or other authorities exercising jurisdiction over the electrical construction work and the project.
    - 1. The National Electrical Code (NFPA 70) - 2014 Edition
    - 2. The National Electrical Safety Code (ANSI C-2)
    - 3. The Life Safety Code (NFPA 101) - 2012 Edition
    - 4. The International Building Code - 2012 Edition
    - 5. Regulations of the local utility company with respect to metering and service entrance.

6. Municipal and State ordinances governing electrical work.

- B. All required permits and inspection certificates shall be obtained, and made available at the completion of the work. Permits, inspections, and certification fees shall be paid for as a part of the electrical work.

1.09 DEVIATIONS:

- A. No deviations from the plans and specifications shall be made without the full knowledge and consent of the Architect or his authorized representative.
- B. Should the Contractor find at any time during progress of the work that, in his judgment, existing conditions make desirable a modification in requirements covering any particular item or items, he shall report such items promptly to the Architect for his decision and instruction.

1.10 COOPERATION:

- A. This Contractor shall schedule his work and in every way possible cooperate with all other Contractors on the job to avoid delays, interferences, and unnecessary work. He shall notify them of all openings, hangers, excavations, etc., so that proper provisions shall be made for his work. This shall not relieve him of the cost of cutting, when such is required.
- B. This Contractor shall do all cutting and excavating necessary for the complete installation of his work, but he shall not cut the work of any other Contractor without first consulting the Architect. He shall repair any work damaged by him or his workmen, employing the services of the Contractor whose work is damaged. Saw cut existing slab as required for routing conduits and floor boxes noted to be installed in existing floors. Restore to original finish.
- C. This Contractor shall by all means coordinate the location of ceiling lighting fixtures, both recessed and surface mounted, with the Ceiling Contractor so that proper hangers and supports shall be provided.
- D. Any conflict between electrical and other trades shall be reported before construction starts. No extra charges will be approved for work resulting from failure to coordinate with other trades.

1.11 INSTALLATION:

- A. Raceways, fixtures, devices, and other electrical equipment shall be installed in a neat and workmanlike manner and in accordance with recognized good practice for a first class installation.
- B. The Architect or his representative shall have the authority to reject any workmanship not complying with the contract documents.

- C. The Electrical Contractor shall personally or through an authorized licensed and competent electrician, constantly supervise the work from beginning to complete and final inspection.
- D. Electrical equipment shall be installed in accordance with manufacturer's recommendations.
- E. Locations of proposed raceway, riser, location of structural elements, location and size of chases method and type of construction of floors, walls, partitions, etc., shall be verified before construction starts.
- F. Consult owner and utility companies for underground lines before any underground work is started. Contractors shall be responsible for any damage.
- G. All empty conduits shall have a pull string installed. All flush recessed boxes shall have black plates installed.

**1.12 EXCAVATION, TRENCHING AND BACKFILLING:**

- A. General. The Contractor shall perform all excavation to install conduit structures and equipment specified in this Division of the Specifications. During excavation, materials for backfilling shall be piled back from the banks of the trench to avoid over-loading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and other excavations and water accumulating therein shall be removed by pumping. All excavations shall be made by open cut. No tunneling shall be done. All requirements of OSHA shall be complied with.
- B. Trench Excavation. The bottom of the trenches shall be graded to provide uniform bearing and support for each section of the conduit on undisturbed soil at every point along its entire length. Over depths shall be backfilled with loose, granular, moist earth, tamped. Removed unstable soil that is not capable of supporting the conduit and replace with specified material.
- C. Backfilling. The trenches shall not be backfilled until it is reviewed by the Architect or his representative. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, and gravel or soft shale, free from large clods of earth or stones, deposited in 6" layers and tamped until the conduit has a cover of not less than the adjacent existing ground but not greater than 2" above existing ground. The backfilling shall be carried on simultaneously on both sides of the trench so that conduit is not displaced. The compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material, except that trenches occurring under paved areas or in areas to be filled shall be backfilled in 6" maximum layers and each layer compacted to 95% maximum density. Settling the backfill with water will not be permitted. Any trenches not meeting compaction requirements or where settlement occurs shall have backfill



removed down to the top of the conduit then backfill with approved materials as specified hereinbefore.

- D. Positively no tree roots are to be damaged, hand dig where required. Damaged trees or shrubbery shall be replaced in kind and must be approved by Engineer.

## 1.13

## MATERIALS:

- A. Materials specified by manufacturer's name shall be used unless approval of other manufacturers are listed in addenda to these specifications. Request for prior approval shall be submitted by mail only. Facsimile will not be acceptable.
- B. Drawings indicating proposed layout of space, all equipment to be installed therein and clearance between equipment shall be submitted, where substitution of materials alter space requirements on the drawings.
- C. Material Standards: All materials shall be new and shall conform to the standards where such have been established for the particular material in question. Publications and Standards of the organization listed below are applicable to materials specified herein.
1. American Society for Testing and Materials (ASTM)
  2. Underwriter's Laboratories, Inc. (UL)
  3. National Electrical Manufacturer Association (NEMA)
  4. Insulated Cable Engineers Association (ICEA)
  5. Institute of Electrical and Electronic Engineers (IEEE)
  6. National Fire Protection Association (NFPA)
  7. American National Standards Institute (ANSI)
- D. Material of the same type shall be the product of one manufacturer.
- E. Materials not readily available from local sources shall be ordered immediately upon approval.
- F. The Architect shall have authority to reject any materials, or equipment, not complying with these specifications and have the Contractor replace materials so rejected immediately upon notification of rejection.
- G. Any material or equipment so rejected shall be removed from the job within 24 hours of such rejection, otherwise the Architect may have same removed at the Contractor's expense.

## 1.14

## EQUIPMENT CONNECTIONS:

- A. All equipment requiring electrical power connections shall be connected under this Division of these specifications.

- B. Where electrical connections to equipment require specific locations, such locations shall be obtained from shop drawings.
- C. Drawings for location of conduit stub-up boxes mounted in wall or floor to serve specific equipment, shall not be scaled.
- D. Electrical circuits to equipment furnished under other sections of these specifications are based on design loads. If actual equipment furnished has loads other than design loads electrical circuits and protective devices shall be revised to be compatible with equipment furnished at no additional cost to the Owner. Any revisions must have prior approval by the Architect. Before submitting shop drawings, Electrical Sub-Contractor shall along with the Mechanical and Plumbing Sub-Contractor review voltage and load requirements for mechanical and plumbing equipment to determine the compatibility between what is being furnished and what is shown in the contract drawings. The Electrical Sub-Contractor shall along with his submittals submit a statement that he has reviewed all shop drawings including review with the Mechanical and Plumbing Sub-Contractors.
- E. Where equipment is indicated to be served thru conduit stub-up, conduit shall be stubbed up not less than four inches above floor where transition shall be made to sealtite flexible conduit for connection to equipment.
- F. The Contractor's attention is invited to other Divisions of these specifications, where equipment requiring electrical service or electrically related work is specified to become fully aware of the scope of work required for electrical service or related work.
- G. Where electricity utilizing equipment is supplied separate from the electrical work, and is energized, controlled or otherwise made operative by electrical work, the testing to provide the proper functional performance of such wiring systems shall be conducted by the trade responsible for the equipment. The electrical work shall, however, include cooperation in such testing and the making available of any necessary testing or adjustments to the electrical equipment.
- H. Heating, air conditioning, and ventilating equipment is specified to be furnished and installed under other sections of these specifications. The controls, likewise are specified to be furnished thereunder. All necessary wiring, wiring troughs and circuit breakers for power for this equipment shall be furnished and installed under this section of the specifications, in accordance with the plans and/or diagrams furnished with the equipment, or shown on these plans. Starters furnished by the Mechanical Contractor shall be installed under this Division of the specifications. Power wiring to auxiliary equipment on a piece of equipment remote from its main terminal box and interlocking of apparatus shall be accomplished under Heating Ventilating Equipment section of the specifications. Conduit and outlets for control wiring shall be furnished and installed under Division 15 of these specifications. Control conductors for

mechanical equipment shall not be installed in same conduit with power conductors.

- I. Contractor is to note that location of disconnect switches shown are schematic in nature. Exact location of disconnect switch and mounting height shall be coordinated with field conditions and equipment shop drawings. Locate disconnect as required to maintain clearances required by National Electrical Code.

**1.15 PRODUCT DELIVERY, STORAGE, HANDLING, & PROTECTION**

- A. Inspect materials upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material. Handle materials in accordance with manufacturer's applicable standards and suppliers recommendations, and in a manner to prevent damage to materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises.
- B. All material, except items specifically designed to be installed outdoors such as pad mounted transformers or stand-by generators, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided by the Contractor. Provide temperature and/or humidity control where applicable. No material for interior installation, including conductors, shall be stored other than in an enclosed weather tight structure. Equipment stored other than as specified above shall be removed from the premises.
- C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

**1.16 CLEANING AND PAINTING**

- A. Remove oil, dirt, grease and foreign materials from all raceways, fittings, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touch-up scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, motor control center, switchboard or equipment enclosures with paint furnished by the equipment manufacturers specifically for that purpose.
- B. Do not paint trim covers for flush mounted panelboards, telephone cabinets, pull boxes, junction boxes and control cabinet unless required by the Architect.

Remove trim covers before painting. Under no conditions shall locks, latches or exposed trim clamps be painted.

- C. Unless indicated on the drawings or specified herein to the contrary, all painting shall be done under the PAINTING Section of these Specifications.
- D. Where plywood backboards are used to mount equipment provided under Division 16, paint backboards with two coats of light grey semi-gloss paint. Plywood shall be 3/4" fire rated plywood. Paint shall be fire retardant paint.

**1.17 GUARANTEE:**

- A. Defective lamps shall be replaced up-to-date of acceptance and shall be guaranteed for two (2) years.
- B. All systems and component parts shall be guaranteed for two years from the date of final acceptance of the complete project. Defects found during this guaranteed period shall be promptly corrected at no additional cost to the Owner. Warranty covers all equipment provided an installed under Division 16.

**1.18 SERVICE:**

- A. The electrical service and telephone/CATV service for this project has been coordinated between the Engineer and the Utility Company. However, before installing service conduit (underground or mast), Contractor shall contact Utility Company and verify voltage, location and type of service. Prior to rough-in, coordinate an on-site meeting with each Utility Company to review exact requirements. Submit letter of coordination to Engineer for review.
- B. Where contract documents show a pad mount transformer provide by Utility Company, the following items shall be coordinated with Civil Plans, Architectural Plans, and Utility Company prior to rough-in.
  - 1. Transformer pad locations shall be a minimum of 10'-0" from any building overhangs, canopies, exterior walls, balcony, exterior stairs and or walkways connected to the building.
  - 2. Transformer pad edge shall be no less than 14'-0" from any door way.
  - 3. Transformer pad edge shall be no less than 10'-0" from any windows or other openings.
  - 4. If the building has an overhang, the 10'-0" clearance shall be measured from a point below the edge of the overhang only if the building is three (3) stories or less. If the building is four (4) stories or more, 10'-0" shall be measured from the outside building wall.

5. Fire escapes, outside stairs, and covered walkways attached to or between buildings, shall be considered part of the building.

Note: This information above has been obtained from the NFPA Section 450-27 and the Office of Insurance and Safety Fire Commissioner Chapter 120-3-3.

6. If required by Utility Company, Contractor shall provide concrete pad for transformer per Utility Company requirements.
7. Contractor shall install meter (provided by Utility Company) on a 6" channel iron set in concrete. Paint channel iron to match transformer. Install 1 1/4" galvanized rigid steel conduit from meter to transformer C.T. compartment.
8. Install a 1" galvanized rigid steel conduit from meter and stubbed up into Main Electrical Room for future energy management monitoring. Install pull string and cap conduit.

#### 1.19 SCHEDULING OF OUTAGES

- A. Electrical work requiring interruption of electrical power which would adversely affect the normal operation of the other portions of the Owner's property, shall be done at time other than normal working hours. Normal working hours shall be considered eight A.M. to five P.M. Monday through Friday.
- B. Schedule all work requiring interruption of electrical power two weeks prior to actual shutdown. Submit schedule in writing to Architect indicating extent of system to be de-energized, date and time when power is intended to be interrupted, and date and time power will be restored. Schedule shall be subject to the review of the Architect and the Representative of the Owner.

END OF SECTION

**SECTION 260003 - ELECTRICAL SUBMITTAL PROCEDURES**

## PART 1 - GENERAL

## 1.01 SUMMARY

- A. Section includes requirements for the preparation of Electrical Division 26 Shop Drawings, Product Data, Samples, and other submittals.

## PART 2 - PRODUCTS

## 2.01 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- B. All submittals shall be submitted in electronic format.
- C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
  - 1. Assemble complete submittal package into indexed files incorporating submittal requirements of each single Specification Section and transmittal form with links enabling navigation to each item.
  - 2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  - 3. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner, containing the following information for EACH SECTION:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name of Construction Manager/General Contractor.
    - e. Name of Electrical Contractor.
    - f. Name of firm or entity that prepared submittal.
    - g. Names of subcontractor, manufacturer, and supplier.
    - h. Specification Section number and title.

- i. Indication of full or partial submittal.
- D. Options: Identify options requiring selection by Architect.
- E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

## 2.02 SUBMITTAL DATA

- G. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
- 1. Mark each copy of each submittal to show which products and options are applicable.
  - 2. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 3. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 4. Submit Product Data before or concurrent with Samples.
- H. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
  - J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

### PART 3 - EXECUTION

#### 3.01 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

#### 3.02 ENGINEER'S ACTION

- C. Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.



END OF SECTION

**SECTION 260010 - LIGHTING AND POWER PANELBOARDS**

## 1.01 SUBMITTALS

- A. Complete panelboard shop drawings shall be submitted, listing as a minimum the following items:
1. Voltage rating.
  2. Bus assembly rating.
  3. Main breaker rating by capacity, number of poles and interrupting rating in RMS symmetrical amperes.
  4. Surface or flush mounting.
  5. Listing of branch breakers by capacity number of poles and interrupting rating in RMS symmetrical amperes.
  6. Top or bottom feed.
  7. A schedule similar to that shown on the drawings, depicting branch breaker arrangement and breaker sizes and giving full explanation for any difference between the two.
  8. Coordinate lug sizes as required for feeders shown on drawings.
- B. Contractor shall submit ¼" layouts of all electrical rooms delineating placement of equipment of minimum required clearances specified in National Electrical Code.

## 1.02 MANUFACTURERS

- A. For the purpose of selecting quality and types of panels, equipment as manufactured by Square "D" Company has been specified. Following manufacturers meeting these specifications are acceptable.
1. G. E.
  2. Siemens
  3. Cutler Hammer

## 1.03 EQUIPMENT

- A. Furnish and install circuit breaker lighting and power panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be of the dead-front safety type, equipped with thermal magnetic molded case circuit breakers with frame and trip rating as shown in the schedule.
- B. Circuit breakers shall be HACR rated, quick-make, quick-break, thermal-magnetic, trip-indicating, and have common trip on all multi-pole breakers. Trip indication shall be clearly shown by the breaker handle taking position between ON and OFF, when the breaker is tripped. Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip setting of not more than 10 times the trip rating of the breakers. Connection to bus in all panels

- shall be bolted. All breakers shall be 20 ampere trip, unless otherwise shown. All breakers shall be minimum for 120/208 volts (10,000) A.I.C. sym. and for 277/480 volts (14,000) A.I.C. unless otherwise noted.
- C. Bus bar connections to the branch circuit breakers shall be the distributed phase type. Three-phase, four-wire bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two or three-pole breakers can be installed at any location. All current-carrying parts of the bus assembly shall be copper. Main ratings shall be as shown in the panelboard schedule on the drawings.
  - D. Panel front shall be provided with a continuous piano hinge on one side. Cutler Hammer "EZ" Trim is not acceptable.
  - E. A steel circuit directory frame permanently attached (spot welded) at factory (not glued), and card with a clear plastic covering shall be provided on the inside of the door. The directory card shall provide a space at least 1/4" high x 3" long for each circuit.
  - F. All panels shall be equipped with a copper equipment grounding bar. The bar shall have lugs of sufficient size to handle all grounding conductors.
  - G. Sub-feed circuit breakers are not permitted in panels unless specifically called for.
  - H. Provide mounting hardware for all spaces shown on panelboard schedule.
  - I. Panelboard circuit numbering shall be such that starting at the top, odd numbering shall be used in sequence down the left hand side and even numbers down the right hand side.
  - J. Except where otherwise indicated on the drawings or required to avoid conflicts, mount the panelboards so the tops of the cabinets will be 6 feet above the finished floors. For panelboards which are too high, mount them so the bottoms of the cabinets will be not less than 6 inches above the finished floors.
  - K. Locate the cabinets so that present and future conduits can be connected to them conveniently. Coordinate the dimensions of the cabinets with the dimensions of the spaces designated for installation prior to fabrication of the cabinets. Cabinet shall be minimum 20" wide.
  - L. Wiring in panelboards shall be neatly grouped and secured with ty-wraps.
  - M. Electrical panels shall not be used as wireways or junction boxes for control conductors.
  - N. Where spaces are called for in a panel, all mounting hardware shall be provided for the frame size indicated.
  - O. Splices in panelboards are not permitted.

END OF SECTION

**SECTION 260015 - FUSES**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted and shall consist of manufacturer's published literature and technical data sufficient for the engineer to determine whether system function will be adversely affected, whether proposed fuses meet this specification, and whether they are equal in quality.

## 1.02 MANUFACTURERS

- A. Acceptable manufacturers are:
1. Littelfuse
  2. Cefco
  3. Gould - Shawmut

## 1.03 EQUIPMENT/MATERIAL

- A. All fuses rated 600 volts or less and used for main, feeder, or branch circuit protection with 200,000 ampere interrupting rating and shall be so labeled. Fuse classes and sizes indicated on the drawings have been selected to provide a fully coordinated selective protection system. To maintain this design, all fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or fuse size, the engineer shall be furnished with sufficient data to ascertain that system function will not be adversely affected.
- B. Current-Limiting Fuses 601-6000 Amperes  
Fuses rated over 600 amperes shall be U.L. Class "L" fuses, and shall have a minimum time delay of 10 seconds at 500% rating.
- C. Current-Limiting Fuses 600 Amperes or Less  
All fuses 600 amperes and below shall be true dual-element time delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees Fahrenheit or less when subjected to a non-load oven test. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or another alloy not subject to stress cracking.
- D. Spare Fuses  
At the time of final acceptance, the contractor shall furnish the owner's representative, not less than three (3) spare fuses of each size and type installed.

END OF SECTION



**SECTION 260020 - RACEWAYS**

## 1.01 SUBMITTALS

- A. Submit manufacturer's literature for each type of conduit or tubing and fittings used in the project.

## 1.02 MANUFACTURERS

- A. Acceptable manufacturers of rigid steel and electrical metallic tubing conduit are:
1. Allied Tube and Conduit Co. (Kwik-Fit)
  2. Wheatland Tube Co.
  3. Triangle
  4. L.T.V.
  5. American Brass
  6. E.T.P.
  7. Robroy
  8. PYTCO
  9. RYMCO
  10. Galvite
- B. Acceptable manufacturer's of polyvinyl chloride (PVC) conduit are:
1. Certainteed
  2. Georgia Pipe
  3. Carlon
  4. Can-Tex
  5. Queen City
- C. Acceptable manufacturer's of conduit fittings, bushings, and locknuts are:
1. O-Z/Gedney
  2. Thomas and Belts
  3. Raco

## 1.03 MATERIALS

- A. All metallic conduit and electric metallic tubing shall be steel, of standard pipe dimensions, smooth inside and out, and shall be galvanized. Where the word "conduit" is used hereinafter it shall mean either rigid steel conduit, electric metallic tubing, flexible steel conduit, liquid tight flexible steel conduit or schedule 40 plastic conduit. Intermediate grade conduit is not acceptable.
- B. Galvanized rigid steel conduit shall be used in all areas where it will be exposed to physical damage. Schedule 40 plastic conduit shall be used underground and in slab-on-grade. In no case shall plastic conduit be exposed; switch to rigid steel conduit when turning up exposed. All other conduit, unless otherwise

specified or called for on the plans, may be galvanized electric metallic tubing. Any exposed conduit on exterior of the building shall be galvanized rigid steel only.

- C. Plastic conduit shall be made from virgin polyvinyl chloride C-300 compound. Conduit and fittings shall carry a UL label. Fitting and cement shall be produced by the same manufacturer as the conduit to assure system integrity.
- D. All conduit shall be concealed in building construction except as noted or shown otherwise. In areas with no finished ceiling and where conduit is run exposed all runs down to switches, receptacles, etc. shall when possible be concealed in wall. It is the intent of these specifications that all conduit will be concealed whenever possible. Where outlets are required to be installed on existing walls in a finished space, raceway and outlet box shall be wiremold surface metal raceway.
- E. EMT fittings shall be compression and made of steel for sizes two inches or smaller, steel set screw type fittings may be used on sizes 2 1/2" or larger. Connectors and couplings shall be rain tight and shall have a nylon insulated throat. All fittings shall be "UL" approved. EMT conduit (in sizes 2 1/2" through 4") provided with integral steel compression or set screw coupling on one (1) end of the conduit is acceptable. Die cast, and indenter type fittings are not acceptable. Fittings for flexible steel conduits and liquid tight flexible conduit shall be steel and have nylon insulated throat.
- F. Rigid steel conduit and EMT shall be not less than 1/2 inch trade size, schedule 40 plastic conduit shall not be less than 3/4" trade size and not less than required by the NEC or indicated. Conduit runs with more than 5 #12 conductors shall not be less than 3/4".
- G. Conduit and EMT systems indicated on the drawings for communication and signaling systems are for typical systems. Install conduit and EMT systems for the system being installed.
- H. Connect individual recessed lighting fixtures to the conduit or EMT system with "maximum 6'-0" flexible, galvanized steel conduit. Use flexible galvanized, steel metal conduit for final connection to all rotating equipment and transformers. The flexible conduits shall be long enough to permit the full range of required movements without strain and to prevent the transmission of vibration. Do not utilize flexible conduit to loop between fixtures and devices.
- I. Galvanized rigid steel conduit couplings and connections:
  - 1. Install standard, conduit-threaded fittings.
  - 2. Ream the ends of conduits after cutting and threading them.
  - 3. For connection to sheet metal boxes, cabinets and other sheet metal enclosures, install locknuts on the inside and outside of the enclosure for each connection. See Section 16110 of these specifications.

- J. EMT couplings and connectors:
1. Ream the ends of EMT after cutting them.
  2. Install the following threadless type fittings:
    - a. Connectors: steel compression type with insulated throat or steel tap-on type with insulated throat.
    - b. Couplings: steel compression or tap-on type.
- K. Installation of plastic conduit:
1. Shall be installed in complete accordance with manufacturer's recommendations.
  2. Shall be a minimum of 2'-0" below finished grade when not covered by concrete.
  3. Shall have properly sized bond wire installed with all circuits.
  4. Bends and turns shall be kept to a bare minimum.
  5. Extreme care shall be taken to avoid crushing or cracking conduit. "DO NOT" run vehicles over exposed conduit under any conditions.
  6. All conduit and fittings shall be solvent welded.
  7. Plastic conduit maybe turned up in masonry walls only. PVC conduit shall be allowed to be routed concealed in masonry walls to a maximum height of 48" A.F.F.
  8. Do not install conduit in slab. All conduit shall be installed a minimum of 6" below slab. Conduits shall not be bunched together. Maintain 1" clearance between conduits.
  9. Plastic conduit shall not be bent with a propane torch or open flame. Contractor shall utilize a heat gun, heat blanket, or hot box. Plastic conduit bent with such shall not be scorched or marred.
- L. Insulated bushings:
1. Install nylon insulated bushings on the end of all rigid conduit.
  2. The insulating material shall be designed for rugged, long service.
  3. Bushings which consist of only insulating material will not be accepted.
  4. Fittings which incorporate insulated bushings will be considered for approval in lieu of fittings with separate bushings.
- M. All couplings and connections in location where water or other liquid or vapor might contact the conduit and EMT shall also be watertight.
- N. Close empty conduit and EMT as complete runs before pulling in the cables and wires.
- O. Install exposed conduit and EMT parallel to or at right angles with the lines of the building. Locate them so they will not obstruct headroom or walkways or cause tripping.
- P. Avoid bends or offsets where practicable:



1. Do not install more bends, offsets or equivalent in any conduit or EMT run than permitted by the NEC.
  2. Make bends with standard conduit bending machines.
  3. Conduit hickies may be used for making slight offsets and for straightening conduits stubbed out of concrete.
  4. Conduit or EMT bent with a pipe tee or vise will not be accepted.
  5. Do not install crushed or deformed conduits or EMT.
- Q. Install conduit or EMT clamps:
1. At intervals as required by the NEC.
  2. Above suspended ceilings, metal supports may be installed as permitted by the NEC, except that conduit cannot be supported or secured to the T-bar grid or from the wire supporting the T-bar grid.
  3. Trapeze, split ring, band or clevis hanger may be installed as permitted by the NEC. Trapeze hangers shall be structural metal channels, angle irons or preformed metal channel shapes with the conduit and EMT runs held on specific center by U bolts, clips or clamps. Do not support conduit from ceiling suspension wire or from other conduit.
  4. Chain, wire or perforated strap supports will not be acceptable. Nor are they acceptable as a means of securing the conduit.
  5. Fasten the clamps and other supports as follows:
    - a. For new masonry or concrete structures, install threaded metal inserts prior to pouring the concrete.
    - b. For existing solid masonry or reinforced concrete structures:
      1. Install expansion anchors and bolts or approved power-set fasteners.
      2. Expansion anchors and bolts shall be not less than 1/4 inch diameter and shall extend not less than 3 inches into the concrete or masonry.
      3. Power-set fasteners shall be not less than 1/4-inch diameter and shall extend not less than 1-1/4-inch into the concrete.
    - c. For hollow masonry install toggle bolts. Bolts supported only by plaster will not be accepted.
    - d. For metal structures install machine screws.
    - e. Attachments to wood plug, rawl plug, soft metal insert or wood blocking will not be permitted.
- R. For vertical runs of conduit of EMT:
1. Install supports for conduit, EMT, cables and wires at intervals as required by the NEC and as indicated on the drawings.
  2. Conduit and EMT supports shall be supported by framing for the floors.

- S. Conduits and EMT shall be kept 6" away from parallel runs of steam or hot water pipes.
- T. Clogged raceways shall be entirely free of obstructions or shall be replaced.
- U. Rigid steel conduit installed underground and in concrete shall be wrapped with Scotchwrap #50 corrosion protection tape.
- V. All empty conduits shall have nylon pull cord installed to provide for installation of cables, conductors or wiring. All empty conduits stubbed out below grade shall have be capped and provided with a concrete marker. All spare conduits stubbed up through slab shall have a cap installed to prevent debris from entering conduit.
- W. Do not combine conduit homeruns. Each homerun shall be separately routed directly to panel unless specifically noted otherwise.
- X. Install service conduit (TV, electrical, and telephone) as follows:
  - 1. All underground entrances shall have metallic sleeves through building foundation walls and extend to undisturbed ground to avoid shear, and shall be full weight, threaded hot-dipped galvanized rigid steel conduit.
  - 2. All 90 degree bends to be rigid metallic conduit, with a radius of not less than 10 times the diameter of the conduit.
  - 3. Maintain a minimum cover of 24 inches below final grade for conduits.
- Y. Do not install conduit in cavity between concrete block and brick. Conduit shall not be stubbed up into this cavity or routed horizontally in cavity.
- Z. All feeder conduits 2" and larger which exceed 100' in length shall have galvanized rigid steel 90 degree elbows.

END OF SECTION



**SECTION 260030 - CONDUCTORS**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted and shall consist of manufacturer's published literature.

## 1.02 MANUFACTURERS

- A. Acceptable manufacturers are:

- |             |                |                   |
|-------------|----------------|-------------------|
| 1. General  | 6. Cyprus Rome | 13. Colonial Wire |
| 2. Okonite  | 7. Essex       |                   |
| 3. Senator  | 8. Carol       |                   |
| 4. Triangle | 9. Southwire   |                   |
| 5. Pirelli  | 10. American   |                   |
| 11. Cerro   | 12. CME        |                   |

- B. All wiring shall be manufactured in the United States.

## 1.03 MATERIALS

- A. Ratings and sizes:

1. Shall be not less than indicated on the drawings and not less than required by the NEC.
2. Minimum size shall be No. 12 AWG copper provided the maximum voltage drops in the control circuits will not adversely affect the operation of the controls.
3. Conductor sizes indicated on the drawings are for copper conductors.

- B. Conductors and ground wires:

1. Shall be copper.
2. Size No. 8 AWG and larger shall be stranded.
3. Size No. 10 AWG and smaller shall be solid.

- C. Conductor insulation:

1. Conductor insulation shall be the NEC type THHN.

- D. Wire shall be factory color coded in size No. 6 and smaller. Color shall be by integral pigmentation with a separate color for each phase, neutral and grounding conductor. Color code per phase shall be continuous throughout the project.

- E. Manufacturer's name and other pertinent information shall be marked or molded clearly on the overall jacket's outside surface or incorporated on marker

tapes within the cables and wires at reasonable intervals along the cables and wires.

- F. Cables and wires indicated on the drawings for communication and signaling systems are for typical systems. Install cables and wires for the system being installed.
- G. All wiring shall be in conduit unless specifically noted otherwise.
- H. Every coil of wire shall be in the original wrapping and shall bear the Underwriters' Label of approval.
- I. Where wires are left for connection to any fixture or an apparatus, spare wire or cables shall be provided at the ends for connections. Fixture connections at the outlet box shall be made with insulated wire connectors.
- J. Outer jackets shall be color coded as follows:
  - 1. Three phase or single phase circuits, 120/208 volts:
    - a. Phase A - Black
    - b. Phase B - Red
    - c. Phase C - Blue
    - d. Neutral - White
    - e. Insulated ground wire - Green
  - 2. Three phase or single phase circuits, 480/277 volts:
    - a. Phase A - Brown.
    - b. Phase B - Orange.
    - c. Phase C - Yellow.
    - d. Neutral - Gray.
    - e. Insulated ground wire - Green.
  - 3. Dedicated neutrals shall be provided for all multi-wire branch circuits and outer jacket shall be provided with appropriate colored tracer.
    - a. 120/208V: white with red tracer, white with blue tracer, white with black tracer.
    - b. 277/480V: gray with brown tracer, gray with orange tracer, gray with yellow tracer.
  - 4. Only for large power cables and wires which do not have color coded jackets: No. 6 and larger.
    - a. Install bands of adhesive non-fading colored tape or slip-on bands of colored plastic tubing over the cables and wires at

- their originating and terminations points and at all outlets of junction boxes.
- b. Color shall be permanent and shall withstand cleanings.
- K. Wiring for signal circuits shall conform to the recommendations of manufacturers of the signal system being installed so the system shall have optimum performance and maximum service continuity. Communication and signaling circuit wiring where run in conduit below grade or in a damp location shall be listed for use in a damp or wet location. Communication and signaling conductors not in conduit shall be rated for plenum use.
- L. No circuit wiring shall be smaller than number 12. Where the homerun exceeds 100'-0" in length, number 10 (minimum) wire shall be used even though all such circuits are not indicated on the plans. All wiring for emergency branch circuits shall be number 10 (minimum) unless noted otherwise.
- M. When installing THHN extra care must be exercised so as not to damage nylon jacket. When nylon jacket is damaged wiring shall be removed from service, and replaced with new conductors.

END OF SECTION



**SECTION 260040 - OUTLETS**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted and shall consist of manufacturer's published literature.

## 1.02 MANUFACTURERS

- A. Acceptable manufacturers are:
1. Raco
  2. Steel City
  3. Appleton
  4. Hubbell

## 1.03 MATERIALS

- A. Boxes shall be galvanized pressed sheet steel for all concealed work.
- B. Where conduit runs are exposed, outlet shall be of the cast metal type.
- C. For concealed work each box shall be provided with a square cornered plaster ring.
- D. Each surface lighting fixture, receptacle and switch shall be provided with flush mounted outlet box. All outlets installed in panels and other architectural features shall be centered. The location of any outlet may be moved as much as 10'-0" by the Architect before the outlet is placed without incurring any extra cost. All dimensions refer to the finished floor line. Outlet boxes shall be pressed sheet steel and shall be galvanized for all concealed work. Where conduit runs are exposed outlets shall be of the cast metal type.
- E. Boxes shall be for the service and the type of outlet and shall not be less than 4" square and 1-1/2" deep except where otherwise specified. Boxes installed in walls shall be provided with a square cornered 1-1/2" plaster ring installed flush with surface of wall. Coordinate depth of plaster ring required for particular wall construction. Each outlet box above ceiling shall be supported from a structural member of the building either directly or by using a substantial and approved metal support. Conduit is not an approved means of support. Boxes installed in wall shall be supported either directly to a stud or between studs utilizing an approved bar hanger. In no case shall switch box support and clips used for mounting boxes in old work be used unless specifically called for. Top of outlet box shall be level.
- F. All ceiling or wall recessed outlet boxes or their associated plaster rings shall be flush with the finished surface. Using coverplate to secure wiring devices or shimming the device is not acceptable. Contractor shall exercise due care when cutting opening in walls or ceilings for outlet boxes so that opening size will permit the proper installation of boxes and devices. Fixture studs in ceilings and bracket outlets shall be bolted with stove bolts or shall be locking type of stud mounting.
- G. In addition to boxes indicated, install enough boxes to prevent damage to cables and wires during pulling-in operations.



- H. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- I. "There shall be no outlets installed back to back. A minimum of 4" shall separate each outlet."
- J. Where the volume allowed per conductor exceeds that allowed in Table 370-6(b) of the NEC for the minimum size outlet specified, a larger size outlet box shall be used and shall be sized in accordance with the table noted above.
- K. Outlet boxes shall be clean and free from dust, paint, dirt, plaster ready mix joint compound and /or any other debris.
- L. Floor boxes shall be:
  - 1. Steel City 665 Series or Walker RFB-4 concealed service floor box and hinged service top, 126 cubic inch total capacity.
  - 2. Each box shall be equipped with 2-duplex receptacles, and provision for two low voltage devices. Coordinate low voltage device brackets with Low Voltage Systems Contractor and provide brackets accordingly to coordinate with devices installed.
  - 3. Color of service top shall be as selected by the Architect.
  - 4. Coordinate installation of floor covering with General Contractor.

## 1.04

## LABELING AND IDENTIFICATION

- A. All junction box cover plates shall be labeled identifying the system it contains. The label shall be neatly hand written with a wide tip permanent non-removable marker and be easily identified. Junction boxes containing high voltage wiring shall include panel and circuit designation (ex. HA - 1,3,5 or LA - 2,4,6). Junction boxes utilized for low voltage system shall be labeled in accordance with the system (ex. FA for Fire Alarm System).

END OF SECTION

**SECTION 260050 - WIRING DEVICES AND DEVICE PLATE**

## 1.01 SUBMITTALS

- A. Submit product data under provisions of Section 26 00 00, "Common Work Results for Electrical".
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

## 1.02 REFERENCES

- A. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- B. FS W-S-896 - Switch, Toggle.
- C. NEMA WD 1 - General-Purpose Wiring Devices.
- D. NEMA WD 5 - Specific-Purpose Wiring Devices.

## 1.03 MANUFACTURERS

- A. For the purpose of selecting quality and type of device, equipment manufactured by Hubbell has been specified. The following manufacturers meeting this specification are acceptable:
  - 1. Pass and Seymour
  - 2. Cooper
  - 3. Leviton

## 1.04 PRODUCTS

- A. Switches: All wall switches shall be rated 20 ampere, 120/277 volts, have self grounding provisions, side wiring only and shall be of the silent type. Color shall be gray. Where shown connected to emergency power circuits, provide red switch.
  - 1. Single pole: HBL 1221.
  - 2. Double pole single throw: HBL 1222.
  - 3. Three way: HBL 1223.
  - 4. Four way: HBL 1224.
- B. Receptacle: All receptacles shall be of the grounding type, of the configuration shown on the drawings and shall be flush wall mounting type. Color shall be gray, with exception of receptacles mounted in Wiremold #V4000 raceway which shall be ivory. Where shown connected to emergency power circuits, provide red receptacles.
  - 1. Standard duplex receptacle: 20 ampere, 125 volt, NEMA type 5-20 R, 2 pole, 3 wire, straight blade, U-grounding slot, specification grade. HBL 5362.

2. Power receptacle with matching plug: 20 ampere, 125/250 volt, NEMA type 14-20, 3 pole 4 wire grounded, straight blade type. HBL 8410.
  3. Power receptacle with matching plug: 20 ampere, 250 volt, NEMA type 6-20R 2-pole, 3 wire grounded, straight blade type. HBL 5462.
  4. Power receptacle with matching plug: 30 ampere, 250 volt, NEMA type 6-30R 2-pole, 3 wire, u-grounded slot, straight blade type. HBL 9330.
  5. Power receptacle with matching plug: 50 ampere, 125/250 volt, NEMA type 14-50R, 3-pole, 4 wire grounded, straight blade type. HBL 9450A.
  6. Ground fault interrupter receptacle: 20 ampere, 125 volts, NEMA type 5-20R, 2-pole, 3-wire with grounded U slot. GF 5262.
- C. Device plates: Plates shall be furnished for all devices and outlets indicated on the drawings (telephone, computer, TV, etc.). All plates on masonry walls shall be oversized jumbo type.
1. Flush mounted plates: Beveled type with smooth rolled outer edge, stainless steel type 302 with brushed finish.
  2. Surface box plates, beveled, galvanized steel, pressure formed for smooth edge to fit box.
  3. Die cast weatherproof cover. Lockable hasp vertical mounting. Intermatic #WP1010MC.

## 1.05

## INSTALLATION

## A. Switches:

1. Switches shall be connected to the live side of the circuit and shall control only the outlets indicated.
2. Conductors shall be looped around the terminal screw.
3. Where more than one switch is indicated in the same location switches shall be gang mounted under a common plate.
4. Where multi-wire switching (360-volt potential) occurs, a barrier shall be provided between switches.
5. Center line of switches in general, shall be set 3'-6" above the floor (off position down) and shall clear the door trim or corner by 4" or center the space occupied.
6. Architectural plans shall be consulted before placing switches so they will in every case be located on the strike side of the door and clear door, chair, window, and baseboard moldings.
7. Switches shall be screwed tight to the boxes and shall not depend on the cover plate to pull them tight.

## B. Receptacles:

1. Conductors shall be looped around the terminal screws, "DO NOT BACK WIRE DEVICES."
2. Receptacles shall be grounded by the green wire bond and shall be pigtailed as shown on the drawings.

3. Receptacles shall be screwed tight to the plaster ring or outlet box and shall not depend on the device plate to pull them tight.
4. Center line of general use receptacles shall be in general, set 18" above the floor with receptacle mounted in the vertical position and with grounding pole at the bottom.
5. Coordinate receptacle height with Architectural drawings and locate so that bottom of receptacle plate shall be 1" above counter or back splash and clear all moldings.
6. Center line of receptacles located adjacent to lavatories in toilets shall be set 3'-6" above floor.
7. Receptacles serving water coolers shall be located within cooler housing or as close to bottom of housing as possible. Cord serving unit shall be as short as possible. In no case shall cord or receptacle be seen from normal viewing angle.
8. All receptacles installed in bathrooms, toilets, within 6 feet of lavatories or sinks or on building exterior shall be ground fault circuit interrupter type.
9. All receptacles installed in kitchens or outdoors shall be GFCI type.

C. Plates:

1. Plates shall be level and all edges shall be in full contact with wall.
2. Plates shall be furnished for all devices and other outlets indicated on the drawings.
3. Install plates on outlet boxes and junction boxes in unfinished areas above ceilings and on surface mounted outlets.
4. Plates shall not be used to keep devices secure.
5. Plates shall be clean and free from dust, plaster or paint and spots.
6. Plate shall cover openings around outlets.

END OF SECTION



**SECTION 260055 - LIGHTING CONTROL SYSTEM**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted as follows:
1. Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces. Shop drawings shall indicate exact location of each device or a RFI to confirm location. Plans are diagrammatical. Contractor to verify all lighting control material requirements from approved shop drawings. "Cut Sheet" submittal not acceptable.
  2. Manufacturer's data on the specific lighting control system and components.
  3. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.

## 1.02 MANUFACTURERS

- A. For the purpose of selecting quality and types of panels, equipment as manufactured by Lithonia "nARP". No Exceptions.

## 1.03 DESCRIPTION OF WORK

- A. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans, detailed in the manufacturer submittal and as further defined herein. Contractor is solely responsible to verify quantity, installation locations and wiring requirements for this project. Specific manufacturers catalog numbers, when listed in this section are for reference only. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.
- B. The system shall include but not be limited by the following list: Pre-wired, microprocessor controlled relay panels with electrically held, electronically latched relays panels controlled via a complete list of communication based accessories including digital switches, digital photocells, Digital Time Clock (DTC) and other devices. Microprocessor Controlled Digital Relay Lighting Control system with Cat.5 communications.

## 1.04 GENERAL REQUIREMENTS

- A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. All Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.
- B. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.
- C. Comply with NEC and all local and state codes as applicable to electrical wiring work.
- D. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, commissioning of the lighting control system, and Owner instruction includes:
  - 1. Confirmation of entire system operation and communication to each device.
  - 2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors
  - 3. Confirmation of system Programming, photocell settings, override settings, etc.
  - 4. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.

## 1.05 MATERIALS

- A. Provide CD version of manufacturers operating software to include graphical interface software.
- B. Provide 2 extra sets of as-built and operating manuals.

## 1.06 INSTALLATION

- A. Mount relay control cabinets adjacent to respective lighting panelboard. Cabinet shall flush mount, per plans. Wiring between relay control cabinet and panelboards to be per local codes and acceptable industry standards.
- B. Switches: Mount switches as per plans. Supply faceplates per plans and specifications. Division 26 is responsible for supplying and installing the required low voltage cable, Category 5, 4 twisted pair, with RJ45 connectors and snagless boots between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester

## C. Wiring

1. Place manufacturer supplied "terminators" at each end of the system bus per manufacturers instructions.
2. Neatly lace and rack wiring in cabinets.
3. Plug in Category 5 patch cable that has been field-tested with a recognized cable tester, at the indicated RJ45 connector provided at each lighting control device, per manufacturers instructions.
4. Use shielded cable for dry contact inputs to lighting control system.
5. Do not exceed 4000ft-wire length for the system bus.
6. All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
7. The specified lighting control system shall be installed by the electrical contractor who shall make all necessary wiring connections to external devices and equipment, to include photocell.

## 1.07

## SYSTEM DESCRIPTION

- A. The lighting control system is a networked system that communicates via Cat.5. The system must be able to communicate with fully digital centralized relay panels, digital switches, photocells, various interfaces and shall include all operational software. The intent of the specification is to integrate all lighting control into one system. Distributed lighting control shall be provided using a networked micro relay panel. Lighting control system shall include all hardware and software. Software to be resident within the lighting control system. System shall provide local access to all programming functions at the master LCP and remote access to all programming functions via dial up modem and through any standard computer workstation running an industry standard internet browser. Lighting control system shall have server built into the master LCP that "serves" HTML pages to any authorize workstation. Non-networked, non-digital, non-server capable systems not acceptable.
- B. System software shall provide real time status of each relay, each zone and each group.
- C. All programs, schedules, time of day, etc, shall be held in non-volatile memory for a minimum of 10 years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- D. System shall be capable of flashing lights Off/On any relay or any zone prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.



- E. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, specification grade line voltage type wall switches, photocell, web based software or other devices connected to programmable inputs in a lighting control panel.
- F. The lighting control system shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP.
- G. System may consist of centralized relay panels, digital switches, photocells and various digital interfaces. Verify exact components specified relay panels and digital switches shall communicate as one network via Cat.5.

## 1.08

## SYSTEM COMPONENTS

- A. Relay Panels:
  - 1. NEMA rated enclosure with screw cover or hinged door. Other NEMA types optional.
  - 2. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.
  - 3. Relay panel input power shall be capable of accepting 120v or 277v without rewiring
  - 4. Control electronics in the low voltage section shall be capable of driving 2 to 16, 30a, 18,000 SCCR rated latching relays, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each relay and every zone, and be able to control relays that default to Open, Normally Open Latching (NOL) or relays that default to Closed, Normally Closed Latching (NCL).
  - 5. Lighting control system shall be digital. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable with RJ45 connectors, providing real time two-way communication with each system component. Analog systems are not acceptable.
  - 6. Unused openings in the cabinet shall be effectively closed.
  - 7. Cabinets shall be grounded as specified in the National Electrical Code.
  - 8. Lugs shall be suitable and listed for installation with the conductor being connected.

9. Distribute and arrange conductors neatly in the wiring gutters.
  10. Follow the manufacturer's torque values to tighten lugs.
  11. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.
- B. Standard Output relays
1. UL Listed 30 Amp, Latching, 18,000 SCCR, 277VAC Ballast and HID and 20 Amp Tungsten at 120 Vac.
  2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #8AWG wires on both the line and the load side.
  3. Relays to be rated for 250,000 operations minimum at a full 30a lighting load, default to closed at normal power loss, Normally Closed Latching (NCL). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
  4. Optional relay types available shall include: Normally Open Latching (NOL) relay rated for 250,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.
- C. Low Voltage Switches
1. All switches shall be digital and communicate via Cat.5. Contact closure style switches, shall not be acceptable. The programming for a digital switch will reside in the switch itself, via double EPROM memory. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
  2. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. System shall provide capability to locally and remotely program each individual switch button, monitor and change function of each button locally and remotely. Each button shall be capable of being programmed for On only, Off only, On/Off (toggle), Raise (Dim up) and Lower (Dim down). Switches requiring low voltage control wires to be moved from one input terminal to another to accomplish these functions are not acceptable.

3. Keyed switches shall be programmable and connect to the lighting controls system bus.
4. Digital switches for high abuse areas shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to three buttons in a single gang. Multi gang versions shall also be available. Touch pads shall be Stainless Steel and capable of handling both high abuse and wash down locations. High abuse switches shall connect to the lighting control system digital bus. Each high abuse switch touch button shall be able to be control any relay or any group in any panel or panels that is part of the lighting control system. Each touch button shall be able to be programmed for On, Off, Toggle or Maintain operation. All programming shall be done locally or remotely via dial up modem or web interface as described in other paragraphs of this section. High abuse switches shall be able to be enabled or disabled digitally. Each touch pad is to be identified as to function by an engraved label. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation.

D. DTC - Digital Electronic Time Clock

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
3. The DTC shall be capable of controlling up to 126 digital devices on a single bus and capable of interfacing digitally with other individual busses using manufacturer supplied interface cards.
4. The DTC shall accept control locally using built in button prompts and use of a 8 line 21-letter display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. Help pages shall display on the DTC screen.
5. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
6. Pre-installed lighting control software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone.

7. DTC shall provide system wide timed overrides. Any relay, group or zone that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

2.01 SERVICE AND SUPPORT

- A. Division 26 Contractor shall contact relay panel manufacturer at least 7 days before project completion. Relay panel manufacturer will run diagnostics and confirm system programming.
- B. Telephone factory support shall be available at no additional cost both during and after the warranty period. The specified manufacturer, at no added cost, shall provide additional remote programming as needed for the operational life of the system.

2.02 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and proper programming to ensure a trouble-free occupancy-based lighting control system. This service shall be provided in the contract at no additional cost to the Owner.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the system.

END OF SECTION



**SECTION 260060 - LED INTERIOR LIGHTING**

## PART 1 - GENERAL

## 1.01 RELATED DOCUMENTS

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

## 2.01 SUMMARY

- A. Section Includes:
  - 1. Interior solid-state luminaires that use LED technology.
  - 2. Lighting fixture supports.
- B. Related Requirements:
  - 1. Section 260055 "Lighting Control System" for panelboards used for lighting control.

## 3.01 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.

## 4.01 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-79] [and] [IES LM-80].
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  - B. Shop Drawings: For nonstandard or custom luminaires.
    1. Include plans, elevations, sections, and mounting and attachment details.
    2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    3. Include diagrams for power, signal, and control wiring.
  - C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
  - D. Product Schedule: For luminaires and lamps.[ Use same designations indicated on Drawings.]
- 5.01 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 fixture/lamp types used on Project; use ANSI and manufacturers' codes.
- 6.01 QUALITY ASSURANCE
- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
  - B. Provide luminaires from a single manufacturer for each luminaire type.
  - C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

## 7.01 DELIVERY, STORAGE, AND HANDLING

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

## 8.01 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

## 2.01 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. Recessed Fixtures: Comply with NEMA LE 4.
- D. Bulb shape complying with ANSI C79.1.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. CRI of 80. CCT of 400 K.
- G. Rated lamp life of 50,000 hours.
- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Internal driver.
- J. Nominal Operating Voltage: 120 V ac or 277 V ac.
  - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- K. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. Clear powder-coat finish.



## 2.01 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 and Globes:

1. 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.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

## D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear 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.

## 3.01 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.

## 4.01 LUMINAIRE FIXTURE SUPPORT COMPONENTS

## A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

- B. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 14 gage.
- C. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.01 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.

#### 3.02 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

#### 3.03 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. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls.
  2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
  2. Ceiling mount with pendant mount with 5/32-inch diameter aircraft cable supports adjustable to 120 inches in length.
  3. Ceiling mount with hook mount.
- H. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
  4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. 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 two (2) locations, at opposite 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.
- J. Flexible conduit and wiring from outlet box to fixture shall be minimum 3/8"C., and minimum #18 THHN conductors. Factory supplied whips of smaller ratings are not acceptable. Where 0-10 volt dimming is utilized, use #18 (TJP), grey/purple jacketed conductor integral to flex.
- 3.04 IDENTIFICATION
- K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260120 " Equipment Identification."

**3.05 FIELD QUALITY CONTROL**

- L. 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.
- M. Luminaire will be considered defective if it does not pass operation tests and inspections.
- N. Prepare test and inspection reports.

END OF SECTION



**SECTION 260070 - DISCONNECT SWITCHES**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted and shall consist of manufacturer's published literature.

## 1.02 MANUFACTURERS

- A. Acceptable manufacturers are:
  - 1. Square "D" Company
  - 2. G. E.
  - 3. Siemens
  - 4. Cutler Hammer

## 1.03 EQUIPMENT

- A. Disconnect switches shall be provided for all motors and strip heaters located out of sight of motor controller, and where specifically indicated on the drawings. Disconnect switches shall disconnect all ungrounded conductors. When exposed to weather, enclosure shall be NEMA - 3R. Switches shall be installed to be fully accessible in accordance with Article 110-26 of the National Electrical Code.
- B. All disconnects shall be heavy duty type and shall be equipped with factory installed equipment ground kit bonded to the can for grounding purposes.
- C. For single phase motors, a single - or double-pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Enclosed safety switches shall be horsepower rated in conformance with Table III of Fed. Spec. W-D-865. Switches shall disconnect all ungrounded conductors.
- D. Each disconnect serving ground mounted exterior A/C units shall be equipped with a padlock (Master 3206) all keyed alike.
- E. All disconnects shall be equipped with provisions to lock the handle in the OFF position.
- F. All disconnects shall be fusible type, fused in accordance with the name plate data on the unit. Disconnects serving water heaters or resistance heat strips shall be fused at 125% of the full load amps of the unit.
- G. Install fuses so that ampere rating can be read without having to remove fuses.
- H. All fuses shall be as noted in Section 260015.
- I. Disconnects shall be identified as required under Section 260120.
- J. Maintain 3'-0" clearance in front of disconnect having voltage rating of 250 volts and 4'-0" clearance in front of disconnect having voltage rating of 480 volts. Do not locate disconnect over other electrical equipment (i.e.: transformers). See 260000-1.14-I.

END OF SECTION



**SECTION 260080 - DRY TYPE TRANSFORMERS**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted and shall include as a minimum the following information:
1. Voltage, phase and KVA ratings
  2. ANSI, NEMA and UL listings
  3. Sound rating
  4. Temperature rise - insulation system data
  5. Taps
  6. Neutral terminal sizing
  7. Electrostatic shield
  8. K Factor rating
  9. Physical dimensions and weight
  10. "Rodent Guard" ventilation cover

## 1.02 MANUFACTURERS

- A. For the purpose of selecting quality and type of transformers, equipment as manufactured by Square D Company has been specified. Where called for on drawings, transformers shall be designed for high harmonic, non-linear loads and equal to NL/NLP Dry Type Transformers as manufactured by Square D Company. The following manufacturers meeting these specifications shall be acceptable:
1. General Electric
  2. Cutler-Hammer
  3. Siemens

## 1.03 EQUIPMENT

- A. Dry type transformers shall be provided where shown to provide 3 phase, 4 wire, 120/208 volt grounded wye service to specific panel boards. Primary rating shall be 480 volts. KVA ratings shall be as shown on the drawings.
- B. Transformer shall be provided with six 2-1/2% full capacity taps, two above and two below unless only four 2-1/2% taps, two above and four below are standard NEMA taps for the specific KVA rating. Sound rating shall not exceed 50 db for those specified above 75 KVA. Temperature rise shall not exceed 115 degrees C. under full load in an ambient of 40 degrees C. Overload capacity shall not be less than 10% at rated voltage. Minimum B.I.L. shall be 10 KV. Vibration dampers shall be provided as a standard feature on all transformers.
- C. Lug kits shall be provided with each transformer.



- D. Enclosure shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49. Accessories [weather shields (500KVA max), wall mounting brackets (75KVA max) and/or ceiling mounting brackets (100KVA max)] shall be provided as shown on the drawings. Ventilation opening at front and back of transformer shall have a "Rodent Guard" cover completely covering the ventilation opening. Cover shall have ventilation holes no larger than  $\frac{1}{2}$ " x  $\frac{1}{2}$ ". Provide on all transformers.
- E. Transformers shall comply with NEMA TP-1-2002 standard for energy efficiency.

## 1.04

## EQUIPMENT (NON LINEAR TYPE TRANSFORMER)

- A. Transformer shall be of the continuous wound construction and shall be impregnated with non hygroscopic, thermosetting varnish. Transformers 15KVA and larger shall have a minimum of 6-2.5% full capacity taps (2+4-).
- B. Transformer insulation system shall be a UL recognized 115 degree C system. Neither the primary or the secondary temperature shall exceed 115 degree C at any point in the coils while carrying their full rating of non-sinusoidal load. Maximum hot spot temperatures and K factor ratings shall be determined per ANSI/IEEE C57.110 - 1986. Maximum hot spot temperature shall equal 115 degree C with respective K factor ratings of 13.0 as shown on the drawings. Manufacturers rating K factors by average temperature rise alone shall not be acceptable.
- C. Transformers shall be constructed with reduced core flux to compensate for harmonic distortion. Oversized primary conductors shall be provided to compensate for circulating harmonic currents. Additional secondary capacity shall be provided to compensate for higher stray loss.
- D. Neutral terminal shall be double sized (200% of secondary phase current) to compensate for additional customer neutral cables.
- E. Transformers shall comply with NEMA TP-1-2002 standard for energy efficiency.
- F. The maximum temperature of the top of the enclosure shall not exceed 50 degree C rise above a 40 degree C ambient.
- G. Transformer shall be supplied with a quality, full width electrostatic shield.
- H. Sound levels shall be guaranteed by the manufacturer not to exceed the following: 15 to 50VA - 45db; 51 to 150KVA - 50db; 151 to 300KVA - 55db; 301 to 500 KVA - 60db. Lower sound levels shall be required as indicated on drawings.

- I. Standards: All insulation materials are to be in accordance with NEMA ST20 standards for 220 Degree C UL component recognized insulation system. Transformers are to be manufactured and tested in accordance with ANSI Standard C57.12.91 and NEMA ST20. Transformers 500KVA or smaller shall be listed by Underwriters Laboratory.
- J. Lug kits shall be provided for each transformer. Provide double barrel lugs as required for 200% neutral.

## 1.05

## INSTALLATION

- A. Primary and secondary connections to dry type transformers shall be made with flexible galvanized steel conduit. Where transformer is installed outside, connections shall be made with seal tite.
- B. Transformers shall be located a minimum of 6" from wall and provide a concrete house keeping pad for each transformer.
- C. Transformers shall be installed on minimum ¾" thick rubber/cork vibration dampening pads. Provide pads at all four corners of transformer.

END OF SECTION



**SECTION 260100 - PULL BOXES, JUNCTION BOXES, AND FITTINGS****PART 1 - GENERAL****1.01 PULL BOXES AND JUNCTION BOXES AND FITTINGS**

- A. Boxes shall be provided in the raceway systems wherever required for the pulling of wires and the making of connections.
- B. Pull boxes of not less than the minimum size required by the National Electrical Code Article 370 shall be constructed of code-gauge galvanized sheet steel. Boxes shall be furnished with screw-fastened covers. Covers on flush wall mounted boxes in well appointed areas (offices, reception, classrooms, media center, etc) shall be minimum 1/16 302 stainless steel. Boxes located on the exterior of the building shall be watertight. Covers shall be secured with tamper proof screws.
- C. Boxes shall be securely and rigidly fastened to the surface of which they are mounted or shall be supported from structural member of the building either directly or by using a substantial and approved metal rod or brace.
- D. All boxes shall be so installed that the wiring contained in them can be rendered accessible without removing part of the building.
- E. Where several circuits pass through a common pull box, the circuits shall be tagged to indicate clearly their electrical characteristics, circuit number and designation.
- F. All junction boxes larger than 4" x 4" flush mounted in wall shall have overlapping cover plate to cover rough-in openings.

**PART 2 - PRODUCTS**

NOT USED

**PART 3 - EXECUTION**

NOT USED

END OF SECTION



**SECTION 260110 - GROUNDING**

## PART 1 GENERAL:

## 1.01 RELATED DOCUMENTS

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

## 1.02 SUMMARY

- A. The work required under this section of the specifications consists of furnishing, installation and connections of the building secondary grounding systems. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be a 3 phase, 4 wire grounded wye delta system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

## 1.03 QUALITY ASSURANCE

- A. Industry Referenced Standards: The following specifications and standards are incorporated into and become a part of this Specification by Reference.
1. Underwriters' Laboratories, Inc. (UL) Publications:  
No.44 Rubber-Insulated Wire & Cables  
No.83 Thermoplastic-Insulated Wires  
No.467 Electrical Grounding & Bonding Equipment  
No.493 Thermoplastic-Insulated Underground Feeder & Branch Circuit Cables  
No.486 Wire Connectors and Soldering Lugs
  2. National Electrical Manufacturers' Standards (NEMA):  
WC-5 Thermoplastic Insulated Wire & Cable  
WC-7 Cross-Linked-Thermosetting Polyethylene Insulated Wire
  3. National Fire Protection Association Publication (NFPA):  
No.70 National Electrical Code (NEC)
- B. Acceptable Manufacturers: Products produced by the following manufacturer which conform to this specification are acceptable.
1. Hydraulically applied conductor terminations:
    - a. Square D
    - b. Burndy

- c. IlSCO
  - d. Scotch (3M)
  - e. Thomas and Betts (T&B)
  - f. Anderson
2. Mechanically applied (crimp) conductor terminations:
- a. Scotch (3M)
  - b. Ideal
  - c. Thomas and Betts (T&B)
  - d. Burndy

## PART 2 PRODUCTS:

## 2.01 GENERAL MATERIALS REQUIREMENTS

- A. Provide all materials under this section of the specifications. All materials shall be new.
- B. All materials shall be UL listed and bear a UL label.
- C. Refer to the specific specification section for the description and requirements of materials mentioned herein for installation.

## 2.02 GROUNDING CONDUCTORS

- A. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the drawings.
- B. Equipment grounding conductors shall be green insulated type THHN conductors sized as indicated on the drawings. Where size is not indicated on the drawings, conductor size shall be determined from the National Electrical Code table of sizes of equipment grounding conductors.
- C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code table on sizes of equipment grounding electrode conductors.

## 2.03 TRANSFORMERS &amp; MOTOR CONTROLLERS

- A. Provide a conductor termination grounding lug bonded to the enclosure of each transformer and motor controller.
- B. Provide an equipment ground bar with bonding screw in each disconnect for grounding purposes.

## 2.04 DEVICES

- A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame. Bond equipment grounding conductor to each outlet box. For isolated ground receptacles, bond equipment grounding conductor to box, and isolated ground conductor to device grounding screw.

## 2.05 GROUND RODS

- A. Ground rods shall be 3/4" x 10'-0" copper clad steel. Connection to all ground rods shall be by exothermic weld.

## PART 3 EXECUTION

## 3.01 INSTALLATION

- A. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.
- B. Service entrance and separately derived electrical systems, grounding electrode system.
  - 1. The neutral conductor of the electrical service serving the premises wiring system shall be grounded to the ground bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the drawings. Grounding electrode conductors shall be installed in rigid, non-metallic conduit to point of ground connection, unless subject to physical damage in which case they shall be installed in galvanized rigid steel. Where metallic conduit is permitted, bond conduit at both ends to grounding electrode conductor with a UL bonding bushing.
  - 2. Bond together the following systems to form the grounding electrode system. All system connections shall be made as close as possible to the service entrance equipment and each connected at the service entrance equipment ground bus. Do not connect electrode systems together except at ground bus.
    - a. Structural steel metal building frame, see detail on drawings
    - b. Main re-bar in a foundation footing
  - 4. Ground the neutral of all dry type transformers as indicated on the drawings.
  - 5. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL listed mechanical ground clamps.
  - 6. Bonding shall be in accordance with the National Electrical Code.



- C. Equipment Grounding Conductor
1. Grounding conductors shall be provided in all branch circuit raceways and cables. Grounding conductors shall be the same AWG size as branch circuit conductors.
  2. Grounding conductors for feeders are typically indicated on the drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.
  3. A grounding conductor shall be installed in all flexible conduit installations. For branch circuits, grounding conductor shall be sized to match branch circuit conductors.
  4. A feeder serving several panelboards shall have a continuous grounding conductor which shall be connected to each related cabinet grounding bar.
  5. The equipment grounding conductor shall be attached to equipment with bolt or sheet metal screw used for no other purpose. Where grounding conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tools.
  6. Ground all motors by drilling and tapping the bottom of the motor junction box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with a crimping tool.
  7. Equipment grounding conductors shall terminate on panelboard, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus. Provide a single terminal lug for each conductor. Conductor shall terminate the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.
- C. Other Grounding Requirements
1. Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a UL listed bond lug, screw, or clip specifically made for such use.

### 3.02 TESTING

- A. Upon completion of the ground rod installation, grounding resistance reading shall be taken before connection is made to the building cold water piping

system. Ground resistance readings shall not be taken within forty-eight hours of rainfall. Results of ground resistance readings shall be forwarded, in writing, immediately to the Architect and Owner.

END OF SECTION



**SECTION 260120 - EQUIPMENT IDENTIFICATION**

## 1.01 SUBMITTALS

- A. Submit sample of laminated plastic identification plate with lettering.

## 1.02 MATERIALS

- A. Laminated plastic plates with 3/16" high white letter etched on black background.
- B. Plates shall be permanently mounted utilizing pop rivets or a permanent mastic/epoxy.
- C. Painted, stenciled or indented tape identification is not acceptable.

## 1.03 ITEM IDENTIFICATION

- A. All electrical apparatus such as wiring troughs, panelboards, individual circuit breakers, transformers and disconnect switches shall have laminated plastic identification plates. Identification shall match labeling shown on plans.
- B. A "steel" circuit directory frame permanently attached at factory (not glued), and a directory card with a plastic covering shall be provided on the inside of each panel door. The directory shall be typed to identify the load fed by each circuit and the areas served. Spaces or room numbers shown on the drawings are not necessarily the final numbers to be assigned to these areas. The Contractors shall before completion of the project obtain from the Architect final space or room numbers so that it can be typed onto directory.
- C. Circuit breakers and disconnects shall identify the equipment served and circuit and panel from which it is served.
- D. On all panelboards the exterior identification plate shall match that on the drawings and the panel and circuit number serving the panel shall be designated within the panel.
- E. Provide laminated plastic label at individual breakers on power panelboards (I-Line) and switchboards. Indicate breaker number and designation of load served.
- F. See Section 260040-1.04-A for required labeling of all junction box covers.

END OF SECTION



**SECTION 260140 - FIRE ALARM SYSTEM**

## 1.01 SUBMITTALS

- A. Shop drawings shall be submitted as follows:
1. Manufacturer's published literature.
  2. One line schematic diagram covering the complete building system.

## 1.02 MANUFACTURERS

- A. Acceptable manufacturers are:
1. Notifier
- B. The acceptable manufacturers systems listed in 1.02 A, shall be installed by the authorized local factory dealer/representative for that product. The factory dealer representative shall hold a current low voltage contractor's license. Factory dealer representative for system shall respond to all service calls within 4 normal working hours. Submit letter to Owner at project closeout and with submittal drawings confirming such.

Any other interested parties shall submit a company resume showing years in business, certification stating that he is an authorized representative for the manufacturer of the equipment he is submitting for approval and that he maintains a fully equipped and stocked service shop and shall respond to service calls within 4 normal working hours, list of key personnel, copies of appropriate licenses and list of recently completed jobs during the normal prior approval period.

- C. The system installed by the acceptable manufacturers listed shall not be password protected by the installer. All programming instructions, passwords, etc., shall be turned over to the Owner such that Owner can service, maintain, and support the system with their own maintenance personnel, if so desired.
- D. The system installed by the acceptable manufacturers listed shall have the capability for the Owner to buy from the manufacturer/installer any repair parts.

## 1.03 SCOPE

- A. This specification covers the installation of a complete electronically operated fire alarm system. The system within the building shall be electrically supervised and shall include, but not be limited to, the following components:
1. Manual non-code type alarm boxes, combination vibrating horns and flashing light, control equipment, duct smoke detectors, conduit, and wiring.

## 1.04 GENERAL REQUIREMENTS

- A. The alarm equipment and all wiring shall be installed and interconnected by a factory certified installer and placed in working order. The name of the manufacturer and serial or identification numbers shall appear on all major components. Electrical supervision of the system shall conform to provisions of Article 240. NFPA Standard 72. Corresponding parts of all similar type equipment units shall be interchangeable, and locks for all cabinets shall be keyed alike. All devices, equipment and combination thereof shall be of the manufacturer's current production. All component parts of the system and the control unit shall be approved for the purpose intended. The stamp, label, seal or certificate of the Underwriter's Laboratories or the Factory Mutual Laboratories shall be considered as acceptable evidence of such approval.
- B. Fire Alarm Subcontractor shall submit a certification stating that he is an authorized representative for the manufacturer of the equipment he is submitting for approval and that he maintains a fully equipped and stocked service shop and shall respond to service within 12 normal working hours.

## 1.05 DRAWINGS AND MANUALS

- A. Three copies of complete instructions for the operation, inspection, testing and maintenance of the system, including wiring diagrams and replacement parts list shall be furnished upon final acceptance of the system. Also provide all special tools that are necessary for the maintenance of the equipment and include one set of fuses for each type and size.

## 1.06 INSTALLATION

- A. A qualified fire alarm technician shall install, adjust and test the equipment. The technician shall be qualified by training and experience in the installation and operation of the fire alarm system specified. The technician shall instruct operating personnel in the operation, adjustment and maintenance of the

system. A statement signed by the person or persons instructed shall be supplied to the Architect prior to final operation.

- B. Provide a written certification that the system is in complete and proper working order and in compliance with all codes.

1.07 SYSTEM OPERATION

- A. Operation of any manual or automatic initiating device shall cause a general alarm to sound.
- B. Also circuits and audible sounding devices shall be electrically supervised. In the event of an open circuit or ground in the system, loss of operation of supervisory power, or other supervised component failure, a trouble signal shall be actuated until the system is restored to normal. A silencing switch shall be provided for silencing the trouble alarm.

1.08 SYSTEM COMPONENTS

- A. Fire alarm control panel: Existing Notifier panel to remain.
- B. Fire alarm subcontractor shall determine the load based on the fire alarm device layout and provide additional power supply modules as required. Provide 120 volt circuit for power supply and serve from nearest 120/208 volt panel. Label panelboard schedules accordingly.
- C. Manual stations: Provide manual alarm stations, semi-flush mounted, of the pull-lever type, key resettable. Housing shall be of cast metal or impact resistance plastic with raised letters designating function and operating instructions. Housing will be red enamel with white lettering.
- D. Signal device: Provide combination low power D.C. strobe/horn with high intensity flashing strobe light for both audible and visual signaling or strobe light for visual signaling only. Where shown on drawings provide combination speaker/strobe for voice evacuation operation. Minimum sound level indoors at 10 feet shall be 90 db. Maximum current draw for horn and strobe light of 0.063 amps, nominal voltage of 24 D.C. Units shall be flush wall mounted 6'-8" above the finished floor at points noted on the drawings. Minimum candela level shall be 75 candela. Candela level for areas under 300 square feet may be 15.
- E. Smoke detectors shall be furnished, installed and connected under Division 26. Power supply for detectors shall be 24 volt D.C. and supplied from Fire Alarm control panel. Detectors shall be photo electric type. Each detector shall have flashing LED for operational walk check.



- F. Smoke detectors in duct work shall be photo electric type furnished and connected under Division 26, installation in duct work shall be accomplished under Division 25. Power supply for detectors shall be 24 volts D.C. and supplied from fire alarm control panel. Provide contacts to automatically shut down fan motors. Sampling tubes shall extend across the entire width of the duct. Provide remote station at readily accessible location in mechanical room, or if air handling unit is above ceiling, mount remote station in wall below ceiling, having LED to indicate alarm condition and key switch to test and reset alarm relay. Mount remote station 6'-0" above finished floor. Detectors for air handling equipment rated over 2000 CFM, but under 15,000 CFM shall be located in the supply duct. Detectors for air handling equipment rated over 15,000 CFM shall be located in the supply and return ducts. Location of detectors in duct work shall be as recommended by detector manufacturer, but in no case shall detector be located ahead of filters. Location of duct detectors shown are schematic in nature only. Verify exact location with unit and duct work placement. Where duct detector is required to be on building exterior, provide weatherproof detector and 120 volt power as required.
- G. Each fire alarm circuit shall be protected from lightning by installing surge protection devices either internally or externally. Circuits run between buildings shall be individually protected in addition to protection at control panel.
- H. All conductors shall be installed in conduit. Conduit installation shall be as covered under Section 260020 of these specifications.
- I. At time of final inspection, Contractor shall turn over a red-lined set of plans showing device location, device address, and device descriptor. Panel shall be fully programmed to denote location of addressable device. Provide a written report denoting that all fire alarm devices have been tested and are operable.

END OF SECTION

## SECTION 260150 - INTRUSION ALARM SYSTEM

## 1.1 SUMMARY

## A. Section Includes:

1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.

## 1.2 DEFINITIONS

## A. PIR: Passive infrared.

## B. RFI: Radio-frequency interference.

## C. Control Unit: System component that monitors inputs and controls outputs through various circuits.

## D. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

## E. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

## F. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.

## G. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

## H. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.

## I. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

## 1.3 SUBMITTALS

## A. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

1. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for master control-unit console, terminal cabinet, racks, and UPS.
2. Master Control-Unit Console Layout: Show required artwork and device identification.
3. Device Address List: Coordinate with final system programming.

## EDC

4. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
  5. Details of surge-protection devices and their installation.
  6. Sensor detection patterns and adjustment ranges.
- B. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.
- C. Qualification Data: For Installer intrusion detection systems integrator.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Data for each type of product, including features and operating sequences, both automatic and manual.
  2. Master control-unit hardware and software data.
- F. Warranty: Sample of special warranty.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.
  2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- 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. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.
- D. Comply with NFPA 70.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment 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 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Description: Hard-wired modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
- B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
  - 1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
  - 2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
  - 3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.
- C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.
- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Operator Commands:
  - 1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
  - 2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
  - 3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
  - 4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
  - 5. Protected Zone Test: Initiate operational test of a specific protected zone.
  - 6. System Test: Initiate system-wide operational test.
  - 7. Print reports.
- F. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- G. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
- H. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

- I. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
- J. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

## 2.2 SYSTEM COMPONENT REQUIREMENTS

- A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:
  - 1. Door hardware specified in Division 8 Section "Door Hardware."
  - 2. Door hardware specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)."
  - 3. Access control system provided by owner.
  - 4. Fire alarm system specified in Division 28 Section "Digital, Addressable Fire-Alarm System."
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
  - 1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient Voltage Suppression."
  - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.
- C. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.
- D. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.
- E. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

## 2.3 ENCLOSURES

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.
- C. Exterior Electronics: NEMA 250, Type 4X, stainless steel.
- D. Corrosion Resistant: NEMA 250, Type 4X, stainless steel.

- E. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

#### 2.4 SECURE AND ACCESS DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
  1. Ademco
  2. Radionics
  3. DSC

#### 2.5 DOOR AND WINDOW SWITCHES

- A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
- B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.
- C. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.
- D. Remote Test: Simulate movement of actuating magnet from master control unit.

#### 2.6 PIR SENSORS

- A. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.
- B. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.
  1. Wall-Mounted Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet.
  2. Ceiling-Mounted Unit Spot-Detection Pattern: Full 360-degree conical.
  3. Ceiling-Mounted Unit Pattern Size: 84-inch diameter at floor level for units mounted 96 inches above floor; 18-foot diameter at floor level for units mounted 25 feet above floor.
- C. Device Performance:
  1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps across two adjacent segments of detector's field of view.
  2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.

## 2.7 MASTER CONTROL UNIT

- A. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
  2. Include a real-time clock for time annotation of events on the event recorder and printer.
  3. Addressable initiation devices that communicate device identity and status.
  4. Control circuits for operation of mechanical equipment in response to an alarm.
- B. Construction: Equipment rack, modular, with separate and independent alarm and supervisory system modules. Alarm-initiating protected zone boards shall be plug-in cards. Arrangements that require removal of field wiring for module replacement are unacceptable.
- C. Comply with UL 609, UL 1023, UL 1076.
- D. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: LCD, one line(s) of 40 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
  3. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
  4. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
  5. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:
    - a. Acknowledge alarm.
    - b. Silence alarm.
    - c. System reset.
    - d. LED test.
  6. Timing Unit: Solid state, programmable, 365 days.
  7. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.
  8. Alarm Indication: Audible signal sounds and an LED lights at master control unit identifying the protected zone originating the alarm appears on LED display at master control unit. Annunciator panel displays a common alarm light and sounds an audible tone.
  9. Alarm activation sounds a siren.

- E. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.
- F. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.
- G. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.
- H. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a cellular dialer. Coordinate cellular service with owner prior to installation. Comply with UL 1635.
- I. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

## 2.8 AUDIBLE AND VISUAL ALARM DEVICES

- A. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet from master control unit.
  - 1. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.

## 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 intrusion detection.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.
- D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
  - 1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
  - 2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.



E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SYSTEM INTEGRATION

A. Intergradation of intrusion detection system by the owner with the following systems and equipment:

1. Electronic door hardware.
2. Access control.

### 3.3 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

D. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

### 3.4 WIRING INSTALLATION

A. Wiring Method for unfinished spaces: Install wiring in metal raceways according to Division 26 Section "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated on drawings. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method for finished spaces: Install wiring in metal raceways according to Division 26 Section "Raceways and Boxes," except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Wires and Cables:

## EDC

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
  2. 120-V Power Wiring: Install according to Division 26 Section "Conductors and Cables" unless otherwise indicated.
  3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 28 Section "Conductors and Cables for Electronic Safety and Security."
  4. Data and Television Signal Transmission Cables: Install according to Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- F. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.
- G. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Electrical Identification."

## 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Division 26 Section "Electrical Identification."
- B. Install instructions frame in a location visible from master control unit.

## 3.6 GROUNDING

- A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.
- B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5 -ohm ground. Measure, record, and report ground resistance.

## 3.7 FIELD QUALITY CONTROL

- A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
  1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.
- B. Perform tests and inspections.

## EDC

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: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
  2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."
- D. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."
- E. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.
- 3.8 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 three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.
- 3.9 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION

**SECTION 260160 - TRANSIENT VOLTAGE SURGE SUPPRESSOR**

## 1.01 SUBMITTALS

- A. Electrical and mechanical drawings for the TVSS shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
- B. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the specified unit.
- C. Documentation of unit's UL 1449 suppression rating shall be included as required product data submittal information.
- D. The contractor shall provide detailed compliance exception statements to all provisions of this specification ten (10) days prior to the bid date.

## 1.02 MANUFACTURERS

- A. For the purpose of selecting quality and type of TVSS units, equipment as manufactured by Current Technology Inc. has been specified. The following manufacturers meeting these specifications are acceptable.
  - 1. Innovative Technology, Inc.
  - 2. Surge Suppression, Inc.
  - 3. Liebert
  - 4. LEA Dynatech
  - 5. Clipper Power Systems
  - 6. Square D
- B. The manufacturer shall provide a Limited Five-Year Warranty, from the date of installation, against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's recommended installation, operation and maintenance instructions.

## 1.03 GENERAL

- A. These specifications describe the electrical and mechanical requirements for a high-energy suppression filter system utilizing transient voltage surge suppression (TVSS) for application in Category C (Main Service Entrance) and Category B (Distribution Panels) areas as defined by the IEEE C62.41 standard.
- B. All Category B (distribution panels) shall include a high frequency attenuation filter for all modes of protection the TVSS is providing.

- C. The unit shall include, but not be limited to, an engineered solid-state high-performance suppression system, utilizing Selenium Cells and/or arrays of fused non-linear voltage dependent Metal Oxide Varistors (MOV).
- D. The suppression system shall not utilize gas tubes, spark gaps, or any other components which might short or crowbar the line, thus leading to interruption of normal power to connected loads. The suppression system shall not incorporate non-field replaceable fusing, circuit boards, plug-in or quick-connect connections as part of any surge current carrying path.
- E. All internal wiring associated with the suppression filter system and subject to surge currents shall utilize low-impedance copper bus bar and/or copper conductor or equal. All internal connections associated with the suppression/filter system and which are subject to surge currents shall be made with compression type solder less lugs and shall be bolted in place.
- F. The unit shall be connected to the panel or switch gear by means of a circuit breaker as specified on the drawings or as recommended by the manufacturer. An integral fused disconnect shall not be furnished with the unit unless otherwise specified. Provide breaker at panel per manufacturer's recommendation.
- G. Units shall be provided in a NEMA 1 type enclosure constructed of minimum 14 gauge steel, painted inside and out with rust inhibiting paint. Surface or flush mount enclosures are specified on the drawings.
- H. The unit shall be installed as close as practical to the wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Maximum 6' connections shall be made with copper conductor and shall not be any longer than is reasonably necessary, avoiding unnecessary bends. When possible, current carrying conductors between the panelboard and the suppression unit shall be twisted together.
- I. The unit shall include mechanical lugs for each phase, neutral and ground, where applicable. The lugs shall accommodate up to a 1/0 AWG copper conductor.
- K. The unit shall include externally mounted visual indicators that monitor the on-line status of each phase of the unit (L.E.D.s, neon lamps, etc.).
- L. The unit shall include the manufacturer's nameplate and UL inspection labels on interior of cabinet.

1.04 STANDARDS

- A. The specified unit shall be designed, manufactured and tested in compliance with the following standards:
  - 1. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-1991 and C62.45-1987).
  - 2. National Electrical Manufacturers Association (NEMA).
  - 3. National Fire Protection Association (NFPA 70 [NEC], 75, and 78).
  - 4. Underwriters Laboratories (UL 1449 and 1283).
- B. The maximum continuous operating voltage (MCOV) or threshold voltage of all suppression components utilized in the unit shall not be less than 125% of the facility's nominal operating voltage for 120 volt.
- C. Based on ANSI/IEEE C62.41-1991's standard 8/20 microsecond current waveform, and in accordance with NEMA Publication No. LS 1-1992, the tested single-pulse surge current capacity, in amps, of the unit shall be no less than the following:

MODE OF PROTECTION

	L-N	L-G	N-G
Distribution Panels:	40,000	40,000	40,000
Total Rating:	80,000		

- D. The unit shall be UL 1449 Listed as a Transient Voltage Surge Suppressor.
- E. The unit shall be factory tested following IEEE C62.41 and C62.45 guidelines without failing or degrading the UL 1449 Surge Suppression Rating by more than 10%.
- F. In accordance with NEMA Standard LS 1-1992, the suppression unit shall provide protection modes as follows:
  - 1. Seven (7) modes of protection for a three phase wye configuration:
    - Line-to-Neutral (3)
    - Line-to-Ground (3)
    - Neutral-to-Ground (1)
- G. The environmental operating parameters for the unit shall meet or exceed the following conditions:

1. Operating temperature range shall be -40 to +60 C (-40 to +140 F).
  2. Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
  3. The unit shall not generate noise levels in excess of 10dB, "A" weighted.
  4. No appreciable magnetic fields shall be generated. Unit shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
- H. For purposes of quality assurance, the unit shall be "burned-in" at the factory, applying nominal voltages for which a particular unit is designed.
- I. A list of customer-replaceable spare parts where applicable shall be included in the unit's documentation set.

END OF SECTION

**SECTION 260175 - FIRESTOPPING**

## 1.01 RELATED DOCUMENTS

- A. The requirements of the general conditions, supplementary conditions, and division 1, general requirements, apply to Work in this Section.

## 1.02 DESCRIPTION

- A. This Section describes the requirements for furnishing and installing firestopping for fire-rated construction. This includes:

- 1. All openings in fire-rated floors and wall assemblies, both blank (empty) and those accommodating penetrating items such as cables, conduits, etc.

## 1.03 REFERENCES

- A. ASTM E 814: "Standard Method of Fire Tests of Through-Penetration Firestops"
- B. UL 1479, UBC 7-5: (both are same as A above)
- C. ASTM E 119: "Standard Method of Fire Tests of Building Construction and Materials"
- D. UL263, UBC 7-1: (both are same as C above)
- E. UL 2079: "Standard for Tests for the Fire Resistance of Building Joint Systems"
- F. Published Through-Penetration Systems by recognized independent testing agencies.
  - 1. UL Fire Resistance Directory.
  - 2. Warnock Hersey Certification Listings, current year.

## 1.04 QUALITY ASSURANCE

- A. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM 814, UL 1479 or UL 2079. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating, when required by code authority, shall be based on the measurement of the temperature rise on the penetrating item(s). The fire test pressure differential of a minimum 0.01 inches of water column is required.
- B. Fire stopping products shall be asbestos free, free of any PCBs and free of any lead.
- C. Do not use any product containing solvents, or that require hazardous waste disposal.



- 1.05 SUBMITTALS
- A. Submit manufacturer's product literature for each type of Firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance, limitation criteria and test data.
  - B. Submit manufacturer's Warranty.
  - C. Material Safety Data Sheets: Submit MSDS for each firestop product.
  - D. Shop Drawings: Show typical installation details for methods of installation. Indicate which firestop materials will be used where and thickness for different hourly ratings.
- 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Deliver materials in the manufacturers' original, unopened containers or packages with manufacturers' name, product identification, lot number, UL or Warnock Hersey labels, and mixing and installation instructions, as applicable.
  - B. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturer.
  - C. All firestop materials shall be installed prior to expiration of shelf life.
- 1.07 PROJECT CONDITIONS
- A. Verify existing conditions and substrates before starting work.
  - B. Do not use materials that are based on organic solvents.
  - C. During installation, provide masking and drop cloths to prevent firestopping products from contaminating any adjacent surfaces.
  - D. Conform to ventilation requirements by manufacturer's installation instructions or Material Safety Data Sheet.
  - E. Weather Conditions: Do not proceed with installation of firestop products when temperatures are in excess of or below the manufacturer's recommendations.
  - F. Schedule installation of firestop products after completion of penetration item installation but prior to covering or concealing of openings.

- G. Coordinate this work with work of other trades.

**PART 2 - PRODUCTS****2.01 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with requirements, provide products of one of the following manufacturers as shown below and further defined by the materials listed in Part 2.02 of this section.
1. The RectorSeal Corporation. Products as listed are a standard of generic types.
  2. International Protective Coatings
  3. 3M Company
  4. Hilti

**2.02 MATERIALS**

- A. Firestop Mortars:
1. Metacaulk Fire Rated Mortar by The RectorSeal Corporation
  2. KBS Mortar by International Protective Coatings
  3. HILTI FS635 Firestop Compound
- B. Firestop Sealants and Caulks:
1. Metacaulk 950 by The RectorSeal Corporation
  2. Metacaulk 835 by The RectorSeal Corporation
  3. Metacaulk 805 by The RectorSeal Corporation
  4. Metacaulk 1000 by The RectorSeal Corporation
  5. CP 25WB+Caulk by 3M
  6. Flame-Safe FS900 Series by International Protective Coatings.
  7. HILTI FS-One Intumescent Firestop Sealant
- C. Firestop Putty:
1. Metacaulk Fire Rated Putty by The RectorSeal Corporation
  2. Metacaulk Fire Rated Putty pads by The RectorSeal Corporation
  3. MPS-2 Moldable Putty Stix by 3M
  4. MPP-4S Moldable Putty Pads by 3M
  5. HILTI CP618 Firestop Putty
- D. Firestop Sleeves:
1. Metacaulk Pipe Collars by The RectorSeal Corporation

2. Plastic Pipe Devices by 3M
  3. HILTI CP6421643 Firestop Collar
- E. Intumescent Wrap Strips:
1. Metacaulk Wrap Strip by The RectorSeal Corporation
  2. FS-195 Wrap Strip by 3M
  3. HILTI
- F. Firestop Mastic:
1. Metacaulk 1100 by The RectorSeal Corporation
  2. HILTI
  3. 3M
- G. Accessories:
1. Forming/Damming Materials: Mineral Fiberboard or other type recommended by manufacturer.
  2. Primer, sealant and solvent cleaner: As recommended by firestop manufacturer.
- H. Where subject to movement, firestop products used shall remain flexible to allow for such normal movement of building structure and penetrating item(s) without affecting the integrity of the firestop system.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to proper and timely completion of the work.
- B. Verify the penetrating item(s) are permanently installed and construction of fire rated assemblies are completed prior to firestop installation.
- C. Prior to installation of firestop systems, clean surfaces of penetrating item(s) that will be in contact with firestop materials. Do not use any cleaning material that will either attack penetrating item(s) or firestop product to be installed.

#### 3.02 CONDITIONS REQUIRING FIRESTOPPING

- A. General:
  1. Provide fire stopping for conditions specified whether or not firestopping is indicated, and, if indicated, whether such material is designated as insulation, safing or otherwise.

2. Insulation types specified in other Sections shall not be installed in lieu of firestopping material specified herein.
- B. Penetrations:
1. Penetrations include conduit, cable, wire, or other elements which pass through one or both outer surfaces of a fire rated floor, wall, or partition.
  2. Except for floors on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to fill such spaces in accordance with ASTM E 814 (UL 1479).
  3. These requirements for penetrations shall apply whether or not sleeves have been provided. Firestop the annular space between sleeve and surrounding surfaces.
- C. Provide firestopping to fill miscellaneous voids and openings in fire rated construction in a manner essentially the same as specified herein before.
- D. All junction boxes larger than 4' x 4" located in a rated wall shall be protected on sides and back of box with firestop putty pads as required to maintain integrity of rated wall.

### 3.03 INSTALLATION

- A. Regulatory requirements: Install firestop products in accordance with fire rated test assemblies as published by either UL or Warnock Hersey or accordance with manufacturer engineer drawings.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration firestop systems.
1. Firestop all holes or voids made in fire resistive assemblies, made by penetrations, to ensure against the passage of flames, smoke, and toxic gases.
  2. Protect materials from damage on surface subjected to traffic and install cover plate as required on any installed firestop system that will or may be subject to traffic.
  3. Tool surfaces of firestop products to provide a smooth and clean appearance.

### 3.04 FIELD QUALITY CONTROL

- A. Follow safety procedures recommended in Material Safety Data Sheets.

- B. Examine penetration firestopped areas to ensure proper installation before concealing or enclosing areas.
- C. Keep areas of work accessible until inspection by Architect.

3.05 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving areas in undamaged and clean conditions.
- B. Neatly cut and trim materials.

END OF SECTION

**SECTION 260230 - CONSTRUCTION REVIEWS INSPECTION AND TESTING**

## 1.01 GENERAL

- A. Comply with Division 1 - General Requirements.

## 1.02 CONSTRUCTION REVIEWS

- A. The Architect or his representative shall observe and review the installation of all electrical systems shown on the drawings and as specified herein.
- B. Before covering or concealing any conduit below grade or slab, in wall or above ceiling, the contractor shall notify the Architect so that he can review the installation.

## 1.03 CONTRACTOR'S FINAL INSPECTION

- A. At the time of the Contractor's final inspection, all systems shall be checked and tested for proper installation and operation by the Contractor in the presence of the Architect or his representative.
- B. The Contractor shall furnish the personnel, tools and equipment required to inspect and test all systems.
- C. Following is a list of items that the contractor must demonstrate to the Architect or his representative as complying with the plans and specifications. Please note that this list does not necessarily represent all items to be covered in the final inspection, but should give the Contractor an idea of what is to be reviewed.
1. Demonstrate that all panels have breakers as specified, ground bar, copper bus, typed directory for circuit identification and that they are free of trash.
  2. Demonstrate that all conduits are supported as required by the National Electrical Code.
  3. Demonstrate that all outlet boxes above or on the ceiling are supported as required by the National Electrical Code.
  4. Demonstrate that outlet boxes in wall or ceilings of combustible materials are flush with surface of wall or ceiling, and that outlet boxes in walls or ceilings of non-combustible materials are so installed that the front edge of the box or plaster ring is not set back more than 1/4".

5. Demonstrate that outlet boxes in wall are secure.
6. Demonstrate that all devices are properly secured to boxes, that device plates are properly aligned and are not being used to secure device.
7. Utilizing a Woodhead No. 1750 testing device, demonstrate that all 125 volt receptacles are properly connected.
8. Demonstrate that all fixtures have specified lamps, ballast and lens, and that they are supported as required by the National Electrical Code or as called for on the drawings or in the specifications.
9. Demonstrate that all disconnects requiring fuses are fused with the proper size and type, and that all disconnects are properly identified.
10. Demonstrate that Fire Alarm System is in proper working order, initiating an alarm signal from each manual and automatic device (including smoke detectors).
11. Demonstrate that Intrusion Alarm System is in proper working order and meeting all requirements outlined in specifications.

END OF SECTION