Maine Medical Center Visitor Garage Expansion

22 Bramhall Street, Portland, ME

PROJECT MANUAL VOLUME 2

Construction Documents

Specification Sections 21 - 28

September 29, 2017

Project # 152182.000

PERKINS+WILL

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FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work under this Section as shown or specified shall be in accordance with the requirements of the Contract Documents.

1.2 DEFINITIONS

A. "Provide": to supply, install and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount, and make complete with all related accessories.

C. "Furnish" or "supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.

F. "Wiring": raceway, fittings, wire, boxes and all related accessories.

G. "Indicated," "shown" or "noted": as indicated, shown, or noted on drawings or specifications.

H. "Similar" or "equal": of base bid manufacturer, equal in quality materials, weight, size, performance, design, and efficiency of specified product, conforming with "Base Bid Manufacturers".

I. "Reviewed" "satisfactory," "accepted", or "directed": as reviewed, satisfactory, accepted, or directed by Architect and/or Engineer.

J. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

K. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow operation of equipment.

L. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

M. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

N. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

O. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

P. 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.

Q. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. NP: Nylon plastic.
4. PE: Polyethylene plastic.
5. PVC: Polyvinyl chloride plastic.

R. The following are industry abbreviations for rubber materials:
1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. EPDM: Ethylene propylene diene terpolymer rubber.

1.3 WORK INCLUDED

A. The work covered by this section includes the construction described in the Contract Documents including all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction, and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work includes, but is not limited to the following:
1. Fire Standpipe System and Equipment.
2. Piping, Valves and Fittings.
3. Identification System.
4. Hydraulic Calculations.
5. Cutting, Patching and Equipment Painting.
6. Hangers, Supports and Guides.
7. Fire Stopping for Pipe Penetration.
8. Pipe Penetration.
9. Alarm Initiating Devices.

B. Related Work not Included in this Division but Specified Elsewhere
1. Fire Alarm Wiring.
2. Finish painting, except for pre-finished equipment or as otherwise specified.
3. Base flashing for piping.
4. Waterproofing.

1.4 COORDINATION OF WORK

A. The fire protection drawings show the general arrangement of piping and appurtenances. Follow these drawings as closely as the actual construction will permit. Conform the fire protection work to the requirements shown on the drawings. Provide offsets, fittings, and accessories, which may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions.

B. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.

C. Carefully check space requirements with other trades to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings.

D. Transmit to other trades all information required for work to be provided under their sections, in ample time for installation.

E. Wherever work interconnects with work of other trades, coordinate with the General Contractor to insure that necessary information is presented so all the necessary connections and equipment may be properly installed. Identify all items (valves, piping, equipment, etc.) In order that the General Contractor will know where to install access doors and panels.

F. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.

G. Furnish and set all sleeves for passage of pipes and conduits through structural masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.

H. Provide required supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.

I. Examine and compare the contract drawings and specifications with the drawings and specifications of other disciplines and report any discrepancies between them to the General Contractor and obtain from him written instructions for changes necessary in the work of this section. Install and coordinate the work of this section in cooperation with the General Contractor installing interrelated work. Before installation, take proper provisions to avoid interferences. All changes required in the work of the contractor, caused by his neglect to do so, are to be made by him at his own expense.

J. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale similar to that of the design drawings, prepared on tracing medium of the same size as contract drawings. With these layouts, coordinate the work with the work of the General Contractor. Such detailed work is to be clearly identified on the drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion, however, include a set of such drawings with each set of as-built drawings. When directed by the Engineer, submit drawings for review, clearly showing the work of this section and its relation to the work of other disciplines before commencing shop fabrication or erection in the field.

K. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship and report any conditions, which prevent performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

L. Provide required anchor bolts, sleeves, inserts and supports. Direct location of anchor bolts, sleeves, inserts and supports to insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports to be paid for by the contractor.

M. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. Properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.

N. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.
   1. Right-of-Way: Lines that pitch have the right-of-way over those that do not pitch, i.e., plumbing drains. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
   2. Make offsets, transitions and changes in direction in pipes as required to maintain proper head room and pitch on sloping lines whether or not indicated

on the drawings. Furnish and install all air vents, drains, etc., as required to affect these offsets, transitions and changes in direction.

O. Install all fire protection work to permit removal (without damage to other parts) of all other parts requiring periodic replacement or maintenance. Arrange pipes and equipment to permit access to valves, cocks, starters, motors, and control components, and to clear the openings of swinging doors and access panels.

P. This contractor shall coordinate his/her work with the work of other trades.

Q. Coordinated Composite Drawings

1. The Contractor shall prepare full coordinated composite drawings for the mechanical, electrical and fire protection trades. The Contractor shall overlay each trade's work (in separate colors) on a sepia set of sheetmetal drawings. All conflicts and potential conflicts shall be clearly identified on the sepia sheetmetal drawings. This shall include but not be limited to conflicts with lights, equipment, piping, ductwork and supports of other trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. Contractor shall have representatives of each trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. Contractor shall have representatives of each trade attend a weekly job site coordination meeting in the Contractor's field office. All trades shall resolve conflicts at these meetings and sign off each sepia sheetmetal drawing indicating acceptance and satisfactory resolution to all conflicts. All conflicts that cannot be resolved shall be brought to the attention of the Engineer for resolution.

1.5 USE OF SITE AND LOAD LIMITATIONS

A. The contractor shall review all available data on the location and types of pipelines and other underground utilities. The contractor shall not operate equipment over the facilities and shall take care not to damage them or otherwise impair their use. The contractor shall make investigation to verify the location of these facilities before proceeding with construction and/or operations in their vicinity.

1.6 CONTRACTOR'S RESPONSIBILITY FOR EVALUATION

A. The Engineer and Owner make no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground or other subsurface conditions which may be encountered during the Work. The contractor must make his own evaluation of existing conditions, which may affect methods or cost of performing the Work, based on his own examination of the facility or other information. Failure to examine the drawings or other information shall not relieve the contractor of his responsibility for satisfactory accomplishment of the Work.

B. The locations of existing services are believed to be as indicated on the drawings. The contractor shall verify the actual location of these services and notify the Engineer of any discrepancies prior to commencing work.

1.7 ACCESS TO FIRE PROTECTION EQUIPMENT

A. The contractor shall not interfere with access to hydrants, fire exits, fire hose stations, fire extinguishers, and fire alarm pull stations. In no case shall the contractor's material or equipment be within twenty-five (25) feet of a hydrant or fire alarm pull station.

1.8 EQUIPMENT AND MATERIALS

A. If products and materials are specified or indicated on the drawings for a specific item or system, the contractor shall use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, in accordance with shop drawings.

B. All products and materials shall be new, clean, free of defects and free of damage and corrosion.

C. No permanent equipment shall be used to provide temporary services during construction.

D. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair.

E. Make certain that all materials selected directly, or by suppliers, conform to the requirements of the contract drawings and specification. Transmittal of such specifications and drawings, information to persons manufacturing and supplying materials to the project, and rigid adherence thereto, is the contractor's responsibility. Acceptance of a manufacturer's name by the Engineer does not release the contractor of the responsibility for providing materials, which comply in all respects with the requirements in the Contract Documents.

F. Applicable equipment and materials to be listed by Underwriters' Laboratories and Manufactured in accordance with ASME, AWWA, NFPA or ANSI standards, and as approved by the local authorities having jurisdiction.

G. Fully lubricate all equipment when installed and prior to final acceptance.

H. Locate valves, etc., to be easily accessible, either in mechanical spaces or through access panels specified herein.

I. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Engineer before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special valves, piping, wiring and accessories.

1.9 QUALITY ASSURANCE

A. Codes Standards and Fees:
   1. Codes and Standards:
      a. Comply with all current governing codes, ordinances and regulations, as well as with requirements of NFPA, UL and all other applicable codes.
      b. Comply with the requirements of the State adopted Building Code, NFPA and other agencies or authorities having jurisdiction over any part of the Work and secure all necessary permits.
      c. Where codes or standards are listed herein, the applicable portions apply.
      d. Plans, specifications, codes and standards are all minimum requirements. Where requirements differ, apply the more stringent.
      e. Should any change in plans or specifications be required to comply with governing regulations, the contractor is to notify the Engineer at the time of submitting his bid.
      f. The codes and standards listed in the Specifications can be obtained from the organizations listed as follows:
         1) OSHA Occupational Safety and Health Act

2) ANSI American National Standard Institute, Inc.
3) ASME American Society of Mechanical Engineers
4) ASTM American Society for Testing and Materials
5) AWWA American Water Works Association
6) UL Underwriters Laboratories, Inc.
7) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
8) NFPA National Fire Protection Association
9) NEMA National Electrical Manufacturers Association
10) AIA American Insurance Association
11) AWS American Welding Society
12) ASA American Standards Association
13) IEEE Institute of Electrical and Electronics Engineers
14) NEC National Electrical Code

g. The particular specification will be identified by appropriate prefix and number only with the latest revision being applicable unless otherwise noted.

2. Fees
   a. Pay all required permit and/or inspection fees.
   b. Pay royalties or fees required in connection with the use of patented devices and systems.
3. Furnish all materials and equipment new, free from defects and with listings or labels of Underwriter's Laboratories, Inc. or other nationally approved testing laboratory.
4. All items of a given type shall be the product of the same manufacturer.
5. All materials and equipment shall be the product of manufacturers regularly engaged in their manufacture.

1.10 PERMITS AND FEES

A. In accordance with General Conditions (AIA Document 201) & Supplementary Conditions for Mechanical & Electrical Work.

B. The Contractor shall give necessary notice, file drawings and specifications with the department having jurisdiction, obtain permits or licenses necessary to carry out this work and pay all fees therefore. The Contractor shall arrange for inspection and test of any or all parts of the work if so required by authorities and pay all charges for same. The Contractor shall pay all costs for, furnish to the Owner before final billing, all certificates necessary as evidence that the work installed conforms with all regulations where they apply to this work.

C. This contractor shall prepare or hire the necessary consultants to prepare and file all plans, calculation, forms, etc. required for filing with all agencies required for this work including but not limited to The DEP (Department of Environmental Protection), DEC (Department of Environmental Conservation, Bureau of Air Resources, EPA Environmental protection Agency, FDNY, etc..

1.11 SPECIAL / CONTROLLED INSPECTION- NYC

A. Special inspection shall be provided by the owner. This contractor shall provide all required services to accomplish these inspections.

1.12 INSPECTIONS / TESTING

A. Independent testing and inspections shall be provided by this contractor who shall hire the inspector or testing agency

1.13 SHOP DRAWINGS

A. Prepare and submit detailed shop drawings for piping work and other distribution services, including locations and sizes of all openings in floor walls and roofs.

B. The work described in any shop drawing submission to be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.

C. Each submitted shop drawing to include a certification that all related job conditions have been checked and that no conflict exists.

D. All drawings are to be submitted sufficiently in advance of field requirements to allow ample time for checking. All submittals to be complete and contain all required and detailed information. Shop drawings with multiple parts to be submitted as a package.

E. If submittals differ from the Contract Document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

F. Review of any submitted data or shop drawings for material, equipment, apparatus, devices, arrangement and layout shall not relieve the contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details to efficiently perform the requirements and intent of the Work. Such review shall not relieve the contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or shop drawings.

G. Each shop drawing to contain job title, the names and phone numbers of the General Contractor and the contractor reference to the applicable design drawing or specification article, date and scale.

H. Within 15 days after award of Contract, submit for review, a list of all material and equipment manufacturers whose products are proposed, as well as names of all subcontractors whom the General Contractor proposes to employ.

I. Within three (3) weeks after award of Contract, submit a list of all shop drawings, which will be submitted in the course of the project. List to show disposition of each item, including date of submission, review, and the like. List to be kept up-to-date throughout entire construction period.

J. Submit shop drawings and manufacturer's data for the following items in accordance with the Contract Documents:
   1. Coordinated, detailed shop layout drawings of all mechanical rooms, services and distribution systems, including plans, profiles and sections.
   2. Details of piping supports, elbows, anchors and miscellaneous appurtenances.
   3. Hangers, supports, inserts, anchors, guides and foundations.
   4. Valves.
   5. Pressure gauges.
   6. Corrosion protective coatings.
   7. Equipment and piping layouts at 3/8 in. scale for the building.
   8. Location and size of sleeves for openings in floors and walls.
   9. Schedule of pipe and fittings, materials and application, valves, escutcheons, air vents, valve tags and schedules, strainers, and water specialties.

10. Building automation systems including descriptions, instruments, and alarms.
11. Flashing.
12. Other shop drawings and submittals as requested within the specification.

1.14 SAMPLES

A. Submit samples of all items with exposed finishes for review.

B. Allow sufficient time for consideration without interfering with job schedule.

C. Duplicate quality and finish to type to be supplied under contract.

D. Identify similar to shop drawings.

1.15 ELECTRONIC COPIES OF AKF DRAWINGS

A. If the contractor requires (.dwg) format, after preparation the drawings will be forwarded only upon receipt of signed acceptance of terms form. Permission from the architect must first be obtained for AKF to include the architectural background as reference. The contractor is to obtain the architects latest drawings directly from the architect.

B. These files are being issued for the convenience of the contractor and the contractor remains responsible for all contract requirements related to the normal shop drawing preparation process.

1.16 SUBMISSIONS:

A. Provide all coordination drawings and shop drawings in 'AutoCad" format, version compatible with owner. All catalog cuts and submittals to be provided in electronic "PDF" format the architect will forward all submissions to the engineer.

B. If paper submissions are to be provided the following shall be adhered to.
   1. Submissions 11 in. X 17 in. or smaller: If the submission is a catalog cut, then the contractor shall submit one original and one copy. Otherwise, they shall submit two copies. The architect will forward the original and one copy (two copies when no original is received) to the engineer. All catalog cuts shall be complete.
   2. Submissions larger than 11 in. X 17 in.: submit two copies to the architect. The architect will forward to the engineer.

C. Indicate on each submission: project name and location, architect and engineer, item identification and approval stamp of prime contractor, subcontractor names and phone numbers, reference to the applicable design drawing or specification article, date and scale.

D. The work described in all shop drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.

E. Each submitted shop drawing is to include a certification that all related job conditions have been checked and verified and that there are no conflicts.

F. All shop drawings are to be submitted to allow ample time for checking in advance of field requirements. All submittals to be complete and contain all required and detailed information. Shop drawings with multiple parts shall be submitted as a package.

G. If submittals differ from the contract document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

1.17 AS-BUILTS AND EQUIPMENT OPERATION INSTRUCTIONS

A. Provide all coordination drawings and shop drawings in AutoCad format, version compatible with owner. All catalog cuts and submittals to be provided in electronic "PDF" format the architect will forward all submissions to the engineer.

B. On completion and acceptance of work, this contractor shall furnish written instructions, equipment manuals and demonstrate to the owner the proper operation and maintenance of all equipment and apparatus furnished under this contract.

C. The contractor shall give one copy of the instructions to the owner and one copy to the engineer. .

D. Final "as-built" drawings indicating as installed conditions shall be provided to the owner, architect and engineer after completion of the installation.

1.18 START-UP

A. Properly lubricate all pieces of equipment.

B. Check and clean all pipes of dirt and debris.

C. Prepare each piece of equipment in accordance with manufacturer's installation instructions and have a copy at the equipment.

D. Check rotation on each motor.

E. Have representatives of each manufacturer present when hereinafter specified, so that equipment will be started up by manufacturer.

1.19 SYSTEMS IDENTIFICATION

A. Piping:
   1. All exposed fire protection piping shall be finish painted red in color unless otherwise directed.
   2. All piping, exposed or concealed, shall be identified as to its service in accordance with OSHA and ANSI Standards by one of the following methods:
      a. Installation of manufactured adhesive band type identification markers, similar to "Quick-Label" by W.H. Brady Company.
   3. Piping identification markings shall be installed as follows:
      a. In each room.
      b. All valve locations.
      c. At shaft walls.
      d. Every 40 feet on continuous runs.

B. Valves:
   1. Valves shall be identified by tag system in accordance with all Maine Medical Center standards.
      a. The new valve tag identification numbers shall be permanently added to all existing valve tag charts.
   2. The service and function of all fire protection valves shall be identified at the valve by signs, similar to Potter Roemer Series 6300, attached to the valves by brass chains.

1.20 OPERATING & MAINTENANCE INSTRUCTION

A. Prepare an operating and maintenance instruction manual which includes the following:
   1. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
   2. Operating instructions for complete system, including:
      a. Normal starting, operating, and shut-down.
      b. Emergency procedures for fire or failure of major equipment.
      c. Summer and winter special procedures.
      d. Day and night special procedures.
   3. Maintenance instructions, including:
      a. Valve tag list and equipment tag list.
      b. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated.
      c. Required cleaning, replacement and/or adjustment schedule.
   4. Manufacturer's data on each piece of equipment, including:
      a. Installation instructions.
      b. Drawings and specifications.
      c. Parts list, including recommended items to be stocked.
      d. Complete wiring and temperature control diagrams.
      e. Marked or revised prints locating all concealed parts and all variations from the original system design.
      f. Test and inspection certificates.
   5. Specific equipment data including, but not limited to, the following:
      a. For Fire Protection System:
      b. Piping.
      c. Valves.
      d. Accessories.
      e. Electric wiring.
      f. Controllers.
   6. For Automatic Control System
      a. Drawings and description of system controlled.
      b. Sequence of operation for each system.
      c. Data on components.
      d. Wiring and piping, schematic any layout, for panels and panelboards.
      e. System operating manual, including set points.

B. Provide instruction of operating personnel.
   1. Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.
   2. Instruction to be by personnel skilled in operation of equipment. Instructions for major equipment to be by equipment manufacturers' representatives.
   3. Make arrangements to give instructions by system and not by building areas.
   4. Provide five (5) instruction sessions not to exceed six (6) hours each.
   5. Instructions on automatic controls to be by manufacturer's representative.

C. Submittals.
   1. Shop Drawings: Submit three copies for review prior to final issuance.
   2. Provide 6 copies of each operation and maintenance manual.
      a. Manuals to be 8-1/2" x 11" size in hard-back, 3-ring loose-leaf binders. Use more than one volume if required. Do not overfill binders.

b. Manuals to be completed and delivered to the Engineer for approval at least 20 days prior to instruction of operating personnel.

3. Prepare separate manuals for the fire protection systems.

1.21 TOOLS FOR OPERATION, ADJUSTMENT AND MAINTENANCE

A. Deliver to Owner's representative all special tools needed for proper operation, adjustment and maintenance of equipment.

1.22 RECORD DRAWINGS

A. The contractor shall maintain a complete set of "Record Drawings" reflecting an accurate dimensional record of all work. These drawings shall be marked up to show the precise location of concealed work and equipment, including concealed piping and valves and all changes and deviations in the plumbing work from that shown on the contract drawings. This requirement shall not be construed as authorization for the contractor to make changes in the layout or work without written definite instruction from the Architect or Engineer.

B. Record dimensions shall clearly and accurately delineate the work as installed; location shall be suitably identified by at least two dimensions to permanent structures.

C. The contractor shall stamp all "Record Drawings" and certify for correctness by signing and dating them.

D. Record drawings submitted to Owner shall consist of 1 set of mylars and 1 set of compact disk's (CD's) with all work provided on Autocad 2000 format.

E. Prior to final acceptance, contractor shall submit certified "Record Drawings" to the Architect/Engineer for review and make changes, corrections or additions as noted by Architect/Engineer. After this review, the drawing shall be delivered to the Owner.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression equipment and piping demolition.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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 to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless 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. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise 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.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Thunderline
      b. Calpico, Inc.
      c. Metraflex Co.
   2. Sealing Elements: EPD Minterlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Plastic. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. General Purpose Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes or as required to facilitate positive drainage of piping.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Insulated Piping: One-piece, stamped-steel type with spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
   2. Existing Piping: Use the following:
      a. Insulated Piping: Split-plate, stamped-steel type with exposed-rivet hinge and spring clips.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

d. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
e. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
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 (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. SteelPipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 21 10 00

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:
   1. Manual dry-type, Class I standpipe systems.

B. Related Sections include the following:
   1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
   2. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
   3. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig (1200 kPa).

C. PE: Polyethylene plastic.

D. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

A. Manual Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).

B. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.
   1. Minimum residual pressure at each hose-connection outlet is the following:
      a. NPS 1-1/2 (DN 40) Hose Connections: [65 psig (450 kPa)] [100 psig].
      b. NPS 2-1/2 (DN 65) Hose Connections: [65 psig] [100 psig (690 kPa)].
   2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:
      a. NPS 2-1/2 (DN 65) Hose Connections: [175 psig (1200 kPa)].

C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and [IBC 2003]

1.6 SUBMITTALS

A. Product Data: For the following:
   1. Piping materials, including specialty fittings.
   2. Pipe hangers and supports, including seismic restraints.
   3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
   4. Hose connections, including size, type, and finish.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Fire-hydrant flow test report.

D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in [NFPA 13] [NFPA 13 and NFPA 14] [NFPA 14]. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

F. Welding certificates.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For [standpipe] specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."

1.8 COORDINATION

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795,[hot-dip galvanized where indicated and] with factory- or field-formed threaded ends.

B. Dry standpipe shall be hot-dip galvanized piping.
1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe[hot-dip galvanized where indicated]. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865[hot-dip galvanized-steel pipe where indicated].

C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll]-grooved ends.
1. Grooved-Joint Piping Systems:
   a. Manufacturers:
      1) National Fittings, Inc.
      2) Victaulic Co. of America.
      3) Ward Manufacturing.
   b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
   c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves,[prelubricated] rubber gasket listed for use with housing, and steel bolts and nuts.

2.3 DIELECTRIC FITTINGS

A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.

B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
1. Manufacturers:
   a. Epco Sales, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Industries, Inc.; Wilkins Div.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig (1200-kPa) minimum working-pressure rating as required for piping system.
1. Manufacturers:
   a. Epco Sales, Inc.
   b. Watts Industries, Inc.; Water Products Div.

D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
   a. Calpico, Inc.
   b. Central Plastics Company.
   c. Pipeline Seal and Insulator, Inc.

2.4 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig (1200 kPa) minimum pressure rating. Valves shall have 300-psig (2070-kPa) pressure rating if valves are components of high-pressure piping system.

B. Gate Valves with Wall Indicator Posts:
1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
3. Manufacturers:
   a. Grinnell Fire Protection.
   b. McWane, Inc.; Kennedy Valve Div.
   c. NIBCO.
   d. Stockham.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3 (DN 80): Ductile-iron body with grooved ends.
4. Manufacturers:
   a. NIBCO.
   b. Milwaukee
   c. Stockham
5. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
   a. Manufacturers:
      1) McWane, Inc.; Kennedy Valve Div.
      2) Mueller Company.
      3) NIBCO.
      4) Milwaukee

D. Check Valves NPS 2 (DN 50) and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Grinnell Fire Protection.
   d. Hammond Valve.
   e. McWane, Inc.; Kennedy Valve Div.
   f. Mueller Company.
   g. NIBCO.
   h. Stockham.

E. Gate Valves: UL 262, OS&Y type.
1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
   a. Manufacturers:
      1) Crane Co.; Crane Valve Group; Crane Valves.
      2) Hammond Valve.
      3) NIBCO.
2. NPS 2-1/2 (DN 65) and Larger: Cast-iron body with flanged ends.
   a. Manufacturers:
      1) Crane Co.; Crane Valve Group; Crane Valves.
      2) Crane Co.; Crane Valve Group; Jenkins Valves.
      3) Milwaukee Valve Company.
      4) Mueller Company.
      5) NIBCO.

2.5 HOSE CONNECTIONS

A. Manufacturers:
1. Elkhart Brass Mfg. Co., Inc.
2. Fire-End and Croker Corp.
3. McWane, Inc.; Kennedy Valve Div.
4. Potter-Roemer; Fire-Protection Div.

B. Description: UL 668, brass or bronze, 300-psig (2070-kPa) minimum pressure rating, hose valve for connecting fire hose. Include angle pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65) as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.
1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Finish: Rough metal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to [NFPA 14] and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

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 thicknesses, 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, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

E. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

3.4 STANDPIPE SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Dry-Type Standpipe System, 175-psig (1200-kPa) Maximum Working Pressure:
1. NPS 4 (DN 100) and Smaller: Threaded-end, galvanized, standard-weight steel pipe; galvanized, cast- or malleable-iron threaded fittings; and threaded joints.

2. NPS 4 (DN 100) and Smaller: Grooved-end, galvanized, standard-weight steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
3. NPS 5 and NPS 6 (DN 125 and DN 150): Threaded-end, galvanized, standard-weight steel pipe; galvanized, cast- or malleable-iron threaded fittings; and threaded joints.
4. NPS 5 and NPS 6 (DN 125 and DN 150): Grooved-end, galvanized, standard-weight steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.5 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by [NFPA 14].
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
   2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by [NFPA 14].
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
      b. Throttling Duty: Use ball valves.

3.6 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
   1. Steel Pipe: Groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
   2. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
   1. NPS 2 (DN 50) and Smaller: Use dielectric unions, couplings, or nipples.
   2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
   3. NPS 5 (DN 125) and Larger: Use dielectric flange insulation kits.

3.7 WATER-SUPPLY CONNECTION

A. Existing

B. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

C. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

D. Hangers and Supports: Comply with NFPA 13 for hanger materials.
   1. Install standpipe system piping according to NFPA 14.

3.8 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to [NFPA 14] and authorities having jurisdiction.

3.9 HOSE-CONNECTION INSTALLATION

A. Install hose connections off standpipes, unless otherwise indicated.

B. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device, unless otherwise indicated.

3.10 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Existing

3.11 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect to existing standpipe.

C. Connect piping to hose valves.

3.12 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in [NFPA 14].

3.13 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
3. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING AND PROTECTION

A. Clean dirt and debris from fire department valves.

3.15 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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SECTION 22 00 00

PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DEFINITIONS

A. "Provide": to supply, install, and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount, and make complete with all related accessories.

C. "Furnish" or "supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.

F. "Wiring": raceway, fittings, wire, boxes and all related accessories.

G. "Indicated," "shown," or "noted": as indicated, shown, or noted on drawings or specifications.

H. "Similar" or "equal": of base bid manufacture, equal in quality materials, weight, size, performance, design, and efficiency of specified product, conforming with "Base Bid Manufacturers."

I. "Reviewed" "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by Architect and/or Engineer.

J. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

K. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow, operation of equipment.

L. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

M. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

N. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

O. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

P. 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.

Q. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. NP: Nylon plastic.
4. PE: Polyethylene plastic.
5. PVC: Polyvinyl chloride plastic.

R. The following are industry abbreviations for rubber materials:
1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. EPDM: Ethylene propylene diene terpolymer rubber.

1.3 WORK INCLUDED

A. The work covered by this section includes the construction described in the Contract Documents including all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction, and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work includes, but is not limited to the following:
1. Domestic Water Systems.
2. Soil, Waste, Vent and Storm Water Systems.
3. Piping, Valves and Fittings
4. Insulation.
5. Freeze Protection electrical cable
6. Identification System.
7. Excavation and Backfill.
8. Cutting, Patching and Equipment Painting.
9. Hangers, Supports and Guides.
10. Rigging of Equipment.
11. Fire Stopping for Pipe Penetration.
12. Pipe Penetration and Drains Counterflashing.
13. Concrete Pads for Equipment.

B. Related Work not Included in this Division but Specified Elsewhere
1. Fire alarm wiring.
2. Finish painting, except for prefinished equipment or as otherwise specified.
3. Concrete work, except equipment inertia and floating bases.
4. Base flashing for piping and drains.
5. Toilet accessories.
6. Waterproofing.
7. Power wiring for motors and motor controllers.
8. Installation of access doors and frames.

1.4 COORDINATION OF WORK

A. The plumbing drawings show the general arrangement of piping and appurtenances. Follow these drawings as closely as the actual construction will permit. Conform the plumbing work to the requirements shown on the drawings. Provide offsets, fittings, and accessories, which may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting

the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions.

B. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.

C. Carefully check space requirements with other trades to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings.

D. Transmit to other trades all information required for work to be provided under their sections, in ample time for installation.

E. Wherever work interconnects with work specified of other trades, coordinate with the General Contractor to insure that all necessary information is presented so that all the necessary connections and equipment may be properly installed. Identify all items (valves, piping, equipment, etc.) in order that the General Contractor know where to install access doors and panels.

F. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.

G. Furnish and set all sleeves for passage of pipes and conduits through structural masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.

H. Provide required supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.

I. Examine and compare the contract drawings and specifications with the drawings and specifications of other disciplines, and report any discrepancies between them to the General Contractor and obtain from him written instructions for changes necessary in the work of this Section. Install and coordinate the work of this section in cooperation with installing interrelated work. Before installation, take proper provisions to avoid interferences. All changes required in the work of the contractor, caused by his neglect to do so, to be made by him at his own expense.

J. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale similar to that of the design drawings, prepared on tracing medium of the same size as contract drawings. With these layouts, coordinate the work with the work of the contractor. Such detailed work is to be clearly identified on the drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion, however, include a set of such drawings with each set of as-built drawings. When directed by the Engineer, submit drawings for review, clearly showing the work of this section and its relation to the work of other disciplines before commencing shop fabrication or erection in the field.

K. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship and report any conditions, which prevent performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

L. Provide required anchor bolts, sleeves, inserts and supports. Direct location of anchor bolts, sleeves, inserts and supports to insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports to be paid for by the contractor.

M. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. Properly locate

such openings and be responsible for any cutting and patching caused by the neglect to do so.

N. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.
   1. Right-of-Way: Lines, which pitch has the right-of-way over those that do not pitch, i.e., plumbing drains. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
   2. Make offsets, transitions and changes in direction in pipes as required to maintain proper head room and pitch on sloping lines whether or not indicated on the drawings. Furnish and install all traps, air vents, drains, etc., as required to affect these offsets, transitions and changes in direction.

O. Install all plumbing work to permit the removal (without damage to other parts) of water heaters and all other equipment requiring periodic replacement or maintenance. Arrange pipes and equipment to permit access to valves, cocks, starters, motors, and control components, and to clear the openings of swinging doors and access panels.

P. Provide access panels in equipment as required for inspection and maintenance of internal parts, etc.

Q. The contractor shall coordinate his work with the work of other trades.

R. Coordinated Composite Drawings
   1. The Contractor shall prepare full coordinated composite drawings for the mechanical, electrical and fire protection trades. The Contractor shall overlay each trade's work (in separate colors) on a sepia set of sheetmetal drawings. All conflicts and potential conflicts shall be clearly identified on the sepia sheetmetal drawings. This shall include but not be limited to conflicts with lights, equipment, piping, ductwork and supports of other trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. Contractor shall have representatives of each trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. Contractor shall have representatives of each trade attend a weekly job site coordination meeting in the Contractor's field office. All trades shall resolve conflicts at these meetings and sign off each sepia sheetmetal drawing indicating acceptance and satisfactory resolution to all conflicts. All conflicts that cannot be resolved shall be brought to the attention of the Engineer for resolution.

1.5 USE OF SITE AND LOAD LIMITATIONS

A. The contractor shall review all available data on the location and types of pipelines and other underground utilities. The contractor shall not operate equipment over the facilities and shall take care not to damage them or otherwise impair their use. The contractor shall make investigation to verify the location of these facilities before proceeding with construction and/or operations in their vicinity.

1.6 CONTRACTOR'S RESPONSIBILITY FOR EVALUATION

A. The Engineer and Owner make no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground or other subsurface conditions which may be

encountered during the Work. The contractor must make his own evaluation of existing conditions, which may affect methods or cost of performing the Work, based on his own examination of the facility or other information. Failure to examine the drawings or other information shall not relieve the contractor of his responsibility for satisfactory accomplishment of the Work.

B. The locations of existing services are believed to be as indicated on the plans. The contractor shall verify the location of these services prior to commencing any work and notify the Engineer of any discrepancies.

1.7 ACCESS TO FIRE PROTECTION EQUIPMENT

A. The contractor shall not interfere with access to hydrants, fire exits, fire hose stations, fire extinguishers and fire alarm pull stations. In no case shall the contractor's material or equipment be within twenty-five (25) ft of a hydrant or fire alarm pull station.

1.8 EQUIPMENT AND MATERIALS

A. If products and materials are specified or indicated on the drawings for a specific item or system, the contractor shall use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, in accordance with shop drawings.

B. All products and materials shall be new, clean, free of defects and free of damage and corrosion.

C. No permanent equipment shall be used to provide temporary services during construction.

D. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair.

E. Make certain that all materials selected directly, or by suppliers, conform to the requirements of the contract drawings and specification. Transmittal of such specifications and drawings, information to persons manufacturing and supplying materials to the project, and rigid adherence thereto, is the Contractor's responsibility. Acceptance of a manufacturer's name by the Engineer does not release the Contractor of the responsibility for providing materials, which comply in all respects with the requirements in the Contract Documents.

F. Applicable equipment and materials to be listed by Underwriters' Laboratories and Manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by local authorities having jurisdiction.

G. Fully lubricate all equipment when installed and prior to final acceptance.

H. Do not operate water systems until piping has been tested and cleaned.

I. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts to have bottom plate and pipe sleeves. Grout all machinery set in concrete under the entire bearing surface. After grout has set, remove all wedges, shims and jack bolts and fill space with grout.

J. Locate valves, traps, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified herein.

K. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Engineer before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special valves, piping, wiring and accessories.

1.9 QUALITY ASSURANCE

A. Codes, Standards and Fees
   1. Codes and Standards:
      a. Comply with all current governing codes, ordinances and regulations, UL and all other applicable codes.
      b. Comply with the requirements of the State adopted Building Code, and other agencies or authorities having jurisdiction over any part of the Work and secure all necessary permits.
      c. Where codes or standards are listed herein, the applicable portions apply.
      d. Plans, specifications, codes and standards are all minimum requirements. Where requirements differ, apply the more stringent.
      e. Should any change in plans or specifications be required to comply with governing regulations, the contractor is to notify the Engineer at the pre-bid meeting.
      f. The codes and standards listed in the Specifications can be obtained from the organizations listed as follows:
         1) OSHA Occupational Safety and Health Act
         2) ANSI American National Standard Institute, Inc.
         3) ASME American Society of Mechanical Engineers
         4) ASTM American Society for Testing and Materials
         5) AWWA American Water Works Association
         6) UL Underwriters Laboratories, Inc.
         7) ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
         8) NEMA National Electrical Manufacturers Association
         9) AIA American Insurance Association
         10) AWS American Welding Society
         11) ASA American Standards Association
         12) IEEE Institute of Electrical and Electronics Engineers
         13) NEC National Electrical Code
         14) UPC Uniform Plumbing Code
      g. The particular specification will be identified by appropriate prefix and number only with the latest revision being applicable unless otherwise noted.
   2. Fees
      a. Pay all required fees.
      b. Pay royalties or fees required in connection with the use of patented devices and systems.

B. Furnish all materials and equipment new, free from defects and with listings or labels of Underwriter's Laboratories, Inc. or other nationally approved testing laboratory.

C. All items of a given type shall be the product of the same manufacturer.

D. All materials and equipment shall be the product of manufacturers regularly engaged in their manufacture.

1.10 PERMITS AND FEES

A. In accordance with General Conditions (AIA Document 201) & Supplementary Conditions for Mechanical & Electrical Work.

B. The Contractor shall give necessary notice, file drawings and specifications with the department having jurisdiction, obtain permits or licenses necessary to carry out this work and pay all fees therefore. The Contractor shall arrange for inspection and test of any or all parts of the work if so required by authorities and pay all charges for same. The Contractor shall pay all costs for, furnish to the Owner before final billing, all certificates necessary as evidence that the work installed conforms with all regulations where they apply to this work.

C. This contractor shall prepare or hire the necessary consultants to prepare and file all plans, calculation, forms, etc.. required for filing with all agencies required for this work including but not limited to The DEP (Department of Environmental Protection), DEC (Department of Environmental Conservation, Bureau of Air Resources, EPA Environmental protection Agency, FDNY, etc..

1.11 INSPECTIONS / TESTING

A. Independent testing and inspections shall be provided by this contractor who shall hire the inspector or testing agency

1.12 SHOP DRAWINGS

A. Prepare and submit detailed shop drawings for piping work and other distribution services, including locations and sizes of all openings in floor walls and roofs.

B. The work described in any shop drawing submission to be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job. Each submitted shop drawing to include a certification that all related job conditions have been checked and that no conflict exists.

C. All drawings to be submitted sufficiently in advance of field requirements to allow ample time for checking. All submittals to be complete and contain all required and detailed information. Shop drawings with multiple parts to be submitted as a package.

D. If submittals differ from the Contract Document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

E. Review of any submitted data or shop drawings for material, equipment apparatus, devices, arrangement and layout shall not relieve the contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details to efficiently perform the requirements and intent of the Work. Such review shall not relieve the contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or shop drawings.

F. Each shop drawing is to contain the job title, the names and phone numbers of the General Contractor and the contractor, references to the applicable design drawing or specification article, date and scale.

G. Within fifteen (15) days after award of Contract, submit for review, a list of all material and equipment manufacturers whose products are proposed, as well as names of all Subcontractors whom the General Contractor proposes to employ.

H. Within three (3) weeks after award of Contract, submit a list of all shop drawings, which will be submitted in the course of the project. List to show disposition of each item, including date of submission, review, and the like. List to be kept up-to-date throughout entire construction period.

I. Submit shop drawings and manufacturer's data for the following items in accordance with the Contract Documents:
   1. Coordinated, detailed shop layout drawings of all mechanical rooms, services and distribution systems, including plans, profiles and sections.
   2. Details of piping supports, elbows, anchors and miscellaneous appurtenances.
   3. Hangers, supports, inserts, anchors, guides and foundations.
   4. Valves.
   5. Corrosion protective coatings.
   6. Equipment and piping layouts at 3/8 in. scale for the building.
   7. Location and size of sleeves for openings in floors and walls.
   8. Schedule of pipe and fittings, materials and application, valves, escutcheons, air vents, valve tags and schedules, strainers, and water specialties.
   9. Flashing.
   10. Equipment identification and certificates.
   11. Pipe Insulation
   12. Freeze Protection electrical cable
   13. Plumbing fixture and trim.
   14. Other shop drawings and submittals as requested within the specification.

1.13 SAMPLES

A. Submit samples of all items with exposed finishes for review.

B. Allow sufficient time for consideration without interfering with job schedule.

C. Duplicate quality and finish to type to be supplied under contract.

D. Identify similar to shop drawings.

1.14 ELECTRONIC COPIES OF AKF DRAWINGS

A. If the contractor requires (.dwg) format, after preparation the drawings will be forwarded only upon receipt of signed acceptance of terms form. Permission from the architect must first be obtained for AKF to include the architectural background as reference. The contractor is to obtain the architects latest drawings directly from the architect.

B. These files are being issued for the convenience of the contractor and the contractor remains responsible for all contract requirements related to the normal shop drawing preparation process.

1.15 SUBMISSIONS:

A. Provide all coordination drawings and shop drawings in ‘AutoCad” format, version compatible with owner. All catalog cuts and submittals to be provided in electronic “PDF” format the architect will forward all submissions to the engineer.

B. If paper submissions are to be provided the following shall be adhered to.
   1. Submissions 11 in. X 17 in. or smaller: If the submission is a catalog cut, then the contractor shall submit one original and one copy. Otherwise, they shall submit two copies. The architect will forward the original and one copy (two copies when no original is received) to the engineer. All catalog cuts shall be complete.
   2. Submissions larger than 11 in. X 17 in.: submit two copies to the architect. The architect will forward to the engineer.

C. Indicate on each submission: project name and location, architect and engineer, item identification and approval stamp of prime contractor, subcontractor names and phone numbers, reference to the applicable design drawing or specification article, date and scale.

D. The work described in all shop drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.

E. Each submitted shop drawing is to include a certification that all related job conditions have been checked and verified and that there are no conflicts.

F. All shop drawings are to be submitted to allow ample time for checking in advance of field requirements. All submittals to be complete and contain all required and detailed information. Shop drawings with multiple parts shall be submitted as a package.

G. If submittals differ from the contract document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

1.16 AS-BUILTS AND EQUIPMENT OPERATION INSTRUCTIONS

A. Provide all coordination drawings and shop drawings in AutoCad format, version compatible with owner. All catalog cuts and submittals to be provided in electronic "PDF" format the architect will forward all submissions to the engineer.

B. On completion and acceptance of work, this contractor shall furnish written instructions, equipment manuals and demonstrate to the owner the proper operation and maintenance of all equipment and apparatus furnished under this contract.

C. The contractor shall give one copy of the instructions to the owner and one copy to the engineer. .

D. Final "as-built" drawings indicating as installed conditions shall be provided to the architect and engineer after completion of the installation.

1.17 START-UP

A. Properly lubricate all pieces of equipment.

B. Check and clean all pipes of dirt and debris, including strainers.

C. Prepare each piece of equipment in accordance with manufacturer's installation instructions and have a copy at the equipment.

D. Fill and vent all water systems.

E. Check rotation on each motor.

F. Have representatives of each manufacturer present when hereinafter specified, so that equipment will be started up by manufacturer.

1.18 SYSTEM IDENTIFICATION

A. Piping:
1. All piping, exposed or concealed shall be identified as to its service in accordance with OSHA and ANSI Standards by one of the following methods:
a. Installation of manufactured adhesive band type identification markers, similar to "Quick-Label" by W.H. Brady Company.
2. Piping identification markings shall be installed as follows:
a. In each room.
b. All valve locations.
c. At shaft walls.
d. Every 40 feet on continuous runs.
3. Valves:
a. Valves shall be identified by a tag system utilizing brass tags at 2 inch minimum diameter and attached to the valves using brass chain.
1) The new valve tag identification numbers shall be permanently added to all existing valve tag charts within the building.
4. Equipment:
a. Identify all controls such as motor starters not in motor control centers, float switches, and alarms.

1.19 OPERATING & MAINTENANCE INSTRUCTION

A. Prepare operating and maintenance instructions manual including operating instructions, maintenance instructions, manufacturer's data, specific equipment data.

B. Provide an alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.

C. Provide operating instructions for complete system, including:
1. Normal starting, operating, and shut-down
2. Emergency procedures for fire or failure of major equipment
3. Summer and winter special procedures
4. Day and night special procedures

D. Provide maintenance instructions, including:
1. Valve tag list and equipment tag list
2. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated
3. Required cleaning, replacement and/or adjustment schedule

E. Provide manufacturer's data on each piece of equipment, including:
1. Installation instructions.
2. Drawings and specifications.
3. Parts list, including recommended items to be stocked.
4. Complete wiring and temperature control diagrams.
5. Marked or revised prints locating all concealed parts and all variations from the original system design.

6. Test and inspection certificates.

F. Provide specific equipment data including, but not limited to, the following:
   1. For Plumbing Systems:
      a. Valves.
      b. Piping.
      c. Accessories.

G. Submittals
   1. Shop Drawings: Submit three copies for review prior to final issuance.
   2. Provide six (6) copies of each operation and maintenance manual.
      a. Manuals to be 8-1/2" x 11 size in hard-back, 3-ring loose leaf binders. Use more than one volume if required. Do not overfill binders.
      b. Manuals to be completed and delivered to the Engineer for approval at least 20 days prior to instruction of operating personnel.
   3. Prepare separate manuals for the Plumbing system.

1.20 TOOLS FOR OPERATION, ADJUSTMENT AND MAINTENANCE

A. Deliver to Owner's representative all special tools needed for proper operation, adjustment and maintenance of equipment.

1.21 RECORD DRAWINGS

A. The contractor shall maintain a complete set of "Record Drawings" reflecting an accurate dimensional record of all work. These drawings shall be marked up to show the precise location of concealed work and equipment, including concealed piping and valves and all changes and deviations in the plumbing work from that shown on the contract drawings. This requirement shall not be construed as authorization for the contractor to make changes in the layout or work without written definite instruction from the Architect or Engineer.

B. Record dimensions shall clearly and accurately delineate the work as installed; location shall be suitably identified by at least two dimensions to permanent structures.

C. The contractor shall stamp all "Record Drawings" and certify for correctness by signing and dating them.

D. Record drawings submitted to Owner shall consist of 1 set of mylars and 1 set of compact disk's (CD's) with all work provided on Autocad 2000 format.

E. Prior to final acceptance, contractor shall submit certified "Record Drawings" to the Architect/Engineer for review and make changes, corrections or additions as noted by Architect/Engineer. After this review, the drawing shall be delivered to the Owner.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION

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SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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 to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

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

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless 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. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.

   2. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      e. Hart Industries, International, Inc.
      f. Watts Industries, Inc.; Water Products Div.
      g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
   1. Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Thunderline

b. Advance Products & Systems, Inc.
c. Calpico, Inc.
d. Metraflex Co.

2. Sealing Elements: EPD Minterlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated .

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
1. Finish: Polished chrome-plated .

D. One-Piece, Stamped-Steel Type: With [set screw] [spring clips] [set screw or spring clips] and chrome-plated finish.

E. Split-Plate, Stamped-Steel Type: With [concealed] [exposed-rivet] hinge, [set screw] [spring clips] [set screw or spring clips], and chrome-plated finish.

F. One-Piece, Floor-Plate Type: Cast-iron floor plate.

G. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. General Purpose Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piececast brass type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece , cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
   2. Existing Piping: Use the following:
      a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
      b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   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 (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. SteelPipe Sleeves: For pipes smaller than NPS 6 (DN 150).

b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Bronze lift check valves.
2. Bronze swing check valves.
3. Iron swing check valves.
4. Iron swing check valves with closure control.
5. Iron, grooved-end swing check valves.
6. Iron, center-guided check valves.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Chainwheels.

B. Related Sections:
1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

D. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.; Apollo Valves.

b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hammond Valve.
b. Milwaukee Valve Company.
c. Mueller Steam Specialty; a division of SPX Corporation.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.

f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. Class 125, RS Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 150, RS Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or gate valves.

B. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
   7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, nonmetallic disc.
3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150, nonmetallic disc.
5. Bronze Gate Valves: Class 150, RS.
6. Bronze Globe Valves: Class 150, nonmetallic disc.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.
5. Iron Gate Valves: Class 125, OS&Y.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe positioning systems.
   8. Equipment supports.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
   3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
   4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment[and obtain approval from authorities having jurisdiction].

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.
   4. Pipe positioning systems.

B. Shop Drawings:[Signed and sealed by a qualified professional engineer.] Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Pipe stands. Include Product Data for components.
   4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to [AWS D1.1, "Structural Welding Code--Steel."] [AWS D1.4, "Structural Welding Code--Reinforcing Steel."] [ASME Boiler and Pressure Vessel Code: Section IX.]

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.2, "Structural Welding Code--Aluminum."
   3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. [Available]Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.

3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.
15. <Insert manufacturer's name.>

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. [Available]Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.
8. <Insert manufacturer's name.>

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.

B. [Available]Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.

5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.
7. <Insert manufacturer's name.>

C. Insulation-Insert Material for Cold Piping: [Water-repellent treated, ASTM C 533, Type I calcium silicate] [Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass] [ASTM C 552, Type II cellular glass] with vapor barrier.

D. Insulation-Insert Material for Hot Piping: [Water-repellent treated, ASTM C 533, Type I calcium silicate] [Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass] [ASTM C 552, Type II cellular glass].

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. [Available]Manufacturers:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.
   c. Masterset Fastening Systems, Inc.
   d. MKT Fastening, LLC.
   e. Powers Fasteners.
   f. <Insert manufacturer's name.>

B. Mechanical-Expansion Anchors: Insert-wedge-type [zinc-coated] [stainless] steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. [Available]Manufacturers:
   a. B-Line Systems, Inc.; a division of Cooper Industries.
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.
   g. <Insert manufacturer's name.>

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN 20 to DN 200).
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN 10 to DN 200).
8. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).
9. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
11. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
12. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

13. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 (DN 65 to DN 900), if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use [powder-actuated fasteners] [or] [mechanical-expansion anchors] instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [NPS 2-1/2 (DN 65)] <Insert other> and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so piping live and dead loads 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 maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

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

b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to [1-1/2 inches (40 mm)] <Insert other>.

3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 [painting Sections.] [Section "High-Performance Coatings."]

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 22 05 33

HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

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

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 10years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
2. Raychem; a division of Tyco Thermal Controls.
3. Thermon Manufacturing Co.

C. Heating Element: Pair of parallel No. 16AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.

F. Maximum Operating Temperature (Power On): 150 deg F (65 deg C).

G. Maximum Exposure Temperature (Power Off): 185 deg F (85 deg C).

H. Maximum Operating Temperature: 300 deg F (150 deg C).

I. Capacities and Characteristics:
1. Maximum Heat Output: 5 W/ft. (16.4 W/m) .
2. Piping Diameter: Line Size
3. Number of Parallel Cables: As required
4. Spiral Wrap Pitch: Per manufacturer's recommandations
5. Volts: [120] [208] [240] [277] [480] <Insert value> V.
6. Phase: <Insert value.>
7. Hertz: <Insert value.>

2.2 CONTROLS

A. Pipe-Mounting Thermostats for Freeze Protection:
1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F (minus 1 to plus 10 deg C).
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

B. Precipitation and Temperature Sensor for freeze protection:
1. Microprocessor-based control with manual on, automatic, and standby/reset switch.
2. Precipitation and temperature sensors shall sense the surface conditions of roof and shall be programmed to energize the cable as follows:
   a. Temperature Span: 34 to 44 deg F (1 to 7 deg C).
   b. Adjustable Delay Off Span: 30 to 90 minutes.

c. Energize Cables: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
d. De-Energize Cables: On detection of a dry surface plus time delay.

3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Minimum 30-A contactor to energize cable or close other contactors.
5. Precipitation sensor shall be freestanding.
6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control system workstation.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Install the following types of electric heating cable for the applications described:
1. Garage drain horizontal piping: Self-regulating, parallel-resistance heating cable.

3.3 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating Cable Installation for Snow and Ice Melting on Roofs and in Gutters and Downspouts: Install on roof and in gutters and downspouts with clips furnished by manufacturer that are compatible with roof, gutters, and downspouts.

C. Electric Heating Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables according to Division 22 Section "Plumbing Insulation."
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

D. Set field-adjustable switches and circuit-breaker trip ranges.

E. Protect installed heating cables, including nonheating leads, from damage.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   1. Test cables for electrical continuity and insulation integrity before energizing.
   2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. [Freestanding] [Restrained] [Freestanding and restrained] spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Seismic snubbers.
12. Restraining braces and cables.
13. [Steel] [Inertia] [Steel and inertia], vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [I] [II] [III].
a. Component Importance Factor: [1.0] [1.5] <Insert value>.
b. Component Response Modification Factor: [1.5] [2.5] [3.5] [5.0] <Insert value>.
c. Component Amplification Factor: [1.0] [2.5] <Insert value>.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): <Insert percent>.

4. Design Spectral Response Acceleration at 1-Second Period: <Insert percent>.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction].
      b. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
   2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
   3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
   4. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
      c. Preapproval and Evaluation Documentation: By [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction], showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For [professional engineer] [and] [testing agency].

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

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

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

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

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.
10. <Insert manufacturer's name>.

D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction].
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least [four] <Insert number> times the maximum seismic forces to which they will be subjected.

E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

G. Restraint Cables: [ASTM A 603 galvanized] [ASTM A 492 stainless]-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

H. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod.

I. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

J. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction].

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).
3. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction] providing required submittals for component.

B. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of [40 feet (12 m)] <Insert dimension> o.c., and longitudinal supports a maximum of [80 feet (24 m)] <Insert dimension> o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction] providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least [four] <Insert number> of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment: <Insert name and drawing designation>.
1. Equipment Location: <Insert room number>.
2. Pads:
   a. Material: [Neoprene] [Rubber] [Hermetically sealed compressed fiberglass].
   b. Thickness: <Insert inches (mm)>.
   c. Number of Pads: <Insert number> thick.
3. Isolator Type: <Insert generic name or designation used in Part 2>.
4. Base Type: <Insert generic name or designation used in Part 2>.
5. Minimum Deflection: <Insert inches (mm)>.
6. Component Importance Factor: [1.0] [1.5].
7. Component Response Modification Factor: [1.5] [2.5] [3.5] [5.0].
8. Component Amplification Factor: [1.0] [2.5].

END OF SECTION

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SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 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.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

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

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
   1. Stencil Material: Fiberboard or metal.

2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook .

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.
2. Valve-tag schedule(s) shall be mounted in locations to be directed by Owner. Mountings shall be in a metal frame with plexi-glass (clear) cover.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "[Interior Painting] [High-Performance Coatings]."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:
1. Low-Pressure, Compressed-Air Piping:
   a. Background Color: [Black] [Blue] [Red] [White] [Yellow] <Insert color>.
   b. Letter Color: [Black] [Blue] [Red] [White] [Yellow] <Insert color>.
2. omestic Water Piping:
   a. Background Color: [Black] [Blue] [Red] [White] [Yellow] <Insert color>.
   b. Letter Color: [Black] [Blue] [Red] [White] [Yellow] <Insert color>.
3. [Sanitary Waste] [and] [Storm Drainage] Piping:
   a. Background Color: [Black] [Blue] [Red] [White] [Yellow] <Insert color>.
   b. Letter Color: [Black] [Blue] [Red] [White] [Yellow] <Insert color>.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
   a. Cold Water: 2 inches (50 mm), round.
   b. Low-Pressure Compressed Air: 2 inches (50 mm), square.
   c.
2. Valve-Tag Color:
   a. Cold Water: Natural.
   b. Low-Pressure Compressed Air: Natural.
3. Letter Color:
   a. Cold Water: Black.
   b. Low-Pressure Compressed Air: Black.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Flexible elastomeric.
      b. Mineral fiber.
   2. Insulating cements.
   3. Adhesives.
   4. Sealants.
   5. Factory-applied jackets.
   6. Field-applied jackets.
   7. Tapes.
   8. Securements.
   9. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Sample Sizes:
      a. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
      b. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).

c. Sheet Jacket Materials: 12 inches (300 mm) square.
d. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Owens Corning; All-Service Duct Wrap.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000(Pipe Insulation.
      c. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJcomplying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Insulco, Division of MFS, Inc.; Triple I.
      b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
      c. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H. B. Fuller Company; 85-20.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H. B. Fuller Company; 85-20.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.
e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76.
b. Insert manufacturer's name; product name or designation.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto PVC Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 11.5 mils (0.29 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

2.8 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products; Bands.
      b. PABCO Metals Corporation; Bands.
      c. RPR Products, Inc.; Bands.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [closed seal] [wing or closed seal].

B. Insulation Pins and Hangers:
   1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.

2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminumsheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Division 07 Section "Penetration Firestopping"firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Construct removable valve insulation covers in same manner as for flanges except divide
   the two-part section on the vertical center line of valve body.
2. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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

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

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

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

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

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

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.9 FINISHES

A. Equipment and Pipe Insulation with ASJ, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, locations of threaded strainers, locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
1. NPS 1 (DN 25) and Smaller: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Storm water and Overflow:
1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

C. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1/2 inch (13 mm) thick.

E. Sanitary Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.

F. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1 inch (25 mm) thick.

G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:
1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

B. Sanitary Waste Piping Where Heat Tracing Is Installed:
1. All Pipe Sizes: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

3.14 APPLIED JACKET SCHEDULE

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

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
1. None.
2. PVC: 20 mils (0.5 mm) thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

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

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
1. Aluminum, Corrugatedwith Z-Shaped Locking Seam: 0.020 inch (0.51 mm) thick.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Escutcheons.
5. Sleeves and sleeve seals.
6. Wall penetration systems.

B. Related Section:
1. Division 22 Section "Facility Water Distribution Piping"

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to SEI/ASCE 7.

1.4 SUBMITTALS

A. Product Data: For the following products:
1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Escutcheons.
6. Sleeves and sleeve seals.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC hydronic piping.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT 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 proceed with interruption of water service without Owner's written permission.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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.

2.2 COPPER TUBE AND FITTINGS

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

B. Soft Copper Tube: [and] ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
   1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

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

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or Tube.

C. Material: High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.

D. Color: Black.

2.5 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

2.6 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

E. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

F. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.7 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.8 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Calpico, Inc.
2. Metraflex, Inc.
3. Thunderline.

B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

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

2.9 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

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 domestic water piping level and plumb.

C. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

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 adjacent to equipment and specialties to allow service and maintenance.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

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: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

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.

E. Install supports for vertical copper tubing every 10 feet (3 m).

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect to existing cold water.

C. Install piping to non-freeze type wall hydrant.

D. Install piping to hose bib.

3.7 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish .
5. Bare Piping in Equipment Rooms: One piece, cast brass .
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:
1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split casting, cast brass.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.8 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:
   1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
   2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe Stack sleeve fittings.
      a. Extend sleeves 2 inches (50 mm) above finished floor level.
      b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
   3. Sleeves for Piping Passing through Gypsum-Board Partitions:
      a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
      b. Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger.
      c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
   4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
   5. Sleeves for Piping Passing through Exterior Concrete Walls:
      a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
      b. Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
      c. Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
      d. Do not use sleeves when wall penetration systems are used.
   6. Sleeves for Piping Passing through Interior Concrete Walls:
      a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
      b. Galvanized-steel sheet sleeves for pipes NPS 6 (DN 150) and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.9 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 WALL PENETRATION SYSTEM INSTALLATION

A. Install wall penetration systems in new, exterior concrete walls.

B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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

C. Piping Tests:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. 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.
4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 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 flow of hot water 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.

3.14 CLEANING

A. Clean and disinfect potable[and non-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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

3.15 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast-copper solder-joint fittings; and soldered joints.

3.16 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 or gate valves for piping NPS 2 (DN 50) and smaller.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:
   1. Vacuum breakers.
   2. Hose bibbs.
   3. Wall hydrants.
   4. Ground hydrants.
   5. Post hydrants.
   6. Drain valves.

B. Related Sections include the following:
   1. Division 22 Section Plumbing for domestic water system.
   2. Division 22 Section "Domestic Water Piping".

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

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

B. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      d. Watts Industries, Inc.; Water Products Div.
      e. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1001.
   3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
   4. Body: Bronze.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. MIFAB, Inc.
      c. Watts Industries, Inc.; Water Products Div.
      d. Woodford Manufacturing Company.
      e. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1011.
   3. Body: Bronze, nonremovable, with manual drain.
   4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   5. Finish:Rough bronze.

C. Pressure Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      d. Watts Industries, Inc.; Water Products Div.
      e. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1020.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
   5. Accessories:
      a. Valves: Ball type, on inlet and outlet.

2.2 HOSE BIBBS

A. Hose Bibbs:
   1. Standard: ASME A112.18.1 for sediment faucets.
   2. Body Material: Bronze.
   3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.3 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Woodford Manufacturing Company.
   g. Zurn Plumbing Products Group; Light Commercial Operation.
   h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for [concealed] [exposed]-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: [Polished nickel bronze] [Chrome plated] <Insert finish>.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: [Polished nickel bronze] [Rough bronze] <Insert finish>.
12. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Woodford Manufacturing Company.
   d. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig (860 kPa).
6. Operation: Loose key .
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.4 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Woodford Manufacturing Company.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet post hydrant.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Casing: Bronze with casing guard.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain into ground when shut off.
10. Vacuum Breaker: Nonremovable, drainable, hose-connection [vacuum breaker complying with ASSE 1011] [or] [backflow preventer complying with ASSE 1052]; and garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Key(s): [One] [Two] with each loose-key-operation wall hydrant.

B. Nonfreeze, Nondraining-Type Post Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Murdock, Inc.
2. Operation: Lever-piston operating mechanism and nondraining water-storage reservoir, designed without drain
3. Length: As required for burial of valve below frost line.
4. Inlet: NPS 1 (DN 25) threaded.
5. Outlet: [NPS 1 (DN 25) outlet and coupling plug for 1-inch (25-mm) hose] [NPS 1 by NPS 3/4 (DN 25 by DN 20) adapter with nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7 on outlet] [or] [NPS 1 by NPS 3/4 (DN 25 by DN 20) adapter with nonremovable, drainable, hose-connection backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet].

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

C. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install shutoff valve on outlet if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

D. Install ground hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

E. Install draining-type post hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. (0.03 cu. m) of concrete block at grade.

F. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each [pressure vacuum breaker] according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

END OF SECTION

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following storm drainage piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

B. Related Sections include the following:
   1. Division 22 Section "Sump Pumps."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
   1. Storm Drainage Piping: [10-foot head of water (30 kPa)] <Insert pressure>.
   2. Storm Drainage, Force-Main Piping: [50 psig (345 kPa)] [100 psig (690 kPa)] [150 psig (1035 kPa)] <Insert pressure>.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to [ASCE 7, "Minimum Design Loads for Buildings and Other Structures."] <Insert applicable code requirement.>

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:
   1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

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

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, [Service] [and] [Extra-Heavy] class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
a. [Available]Manufacturers:
1) ANACO.
2) Fernco, Inc.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

6) <Insert manufacturer's name.>

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
   a. [Available]Manufacturers:
      1) ANACO.
      2) Clamp-All Corp.
      3) Ideal Div.; Stant Corp.
      4) Mission Rubber Co.
      5) Tyler Pipe; Soil Pipe Div.
      6) <Insert manufacturer's name.>

2.5 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. [Available]Manufacturers:
      a. Dallas Specialty & Mfg. Co.
      b. Fernco, Inc.
      c. Logan Clay Products Company (The).
      d. Mission Rubber Co.
      e. NDS, Inc.
      f. Plastic Oddities, Inc.
      g. <Insert manufacturer's name.>
   2. Sleeve Materials:
      a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. [Available]Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Mission Rubber Co.
      c. <Insert manufacturer's name.>

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. [Available]Manufacturers:
      a. ANACO.
      b. <Insert manufacturer's name.>

D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
   1. [Available]Manufacturers:
      a. EBAA Iron Sales, Inc.

b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.
d. <Insert manufacturer's name.>

E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
1. [Available]Manufacturers:
a. SIGMA Corp.
b. <Insert manufacturer's name.>

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground storm drainage piping [NPS 6 (DN 150) and smaller] <Insert pipe size range> shall be[any of] the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; [standard,] [and] [heavy-duty] shielded, stainless-steel couplings; and coupled joints.

3.2 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialities."

E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Fire Plumbing."

G. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

K. Install force mains at elevations indicated.

L. Install engineered controlled-flow storm drainage piping in locations indicated.

M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results Plumbing."

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.4 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves.[Use normally closed type, unless otherwise indicated.]
   2. Install backwater valves in accessible locations.
   3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
2. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
3. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage 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-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

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SECTION 221423

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following storm drainage piping specialties:
   1. Cleanouts.
   2. Garage drains.
   3. Through-penetration firestop assemblies.
   4. Roof drains.
   5. Miscellaneous storm drainage piping specialties.
   6. Flashing materials.

B. Related Sections include the following:
   1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts <Insert drawing designation if any>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
      g. <Insert manufacturer's name.>
      h. Josam Company; Blucher-Josam Div.
      i. <Insert manufacturer's name.>
   4. Standard: [ASME A112.36.2M for cast iron] [ASME A112.3.1 for stainless steel] <Insert standard> for cleanout test tee.
   5. Size: Same as connected drainage piping
   6. Body Material: [Hub-and-spigot, cast-iron soil pipe T-branch] [Hubless, cast-iron soil pipe test tee] [Stainless-steel tee with side cleanout] as required to match connected piping.
   7. Closure: [Countersunk] [Countersunk or raised-head] [Raised-head], [brass] [cast-iron] [plastic] plug.
   8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
   9. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts <Insert drawing designation if any>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Josam Company; Josam Div.
      b. Oatey.
      c. Sioux Chief Manufacturing Company, Inc.
      d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.
h. Zurn Plumbing Products Group; Specification Drainage Operation.
i. <Insert manufacturer's name.>
j. Josam Company; Josam Div.
k. Kusel Equipment Co.
l. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
m. <Insert manufacturer's name.>
n. Josam Company; Blucher-Josam Div.
o. <Insert manufacturer's name.>

4. Standard: ASME A112.36.2M for [adjustable housing] [cast-iron soil pipe with cast-iron ferrule] [heavy-duty, adjustable housing] [threaded, adjustable housing] cleanout.
5. Size: Same as connected branch.
6. Type: [Adjustable housing] [Cast-iron soil pipe with cast-iron ferrule] [Heavy-duty, adjustable housing] [Threaded, adjustable housing].
7. Body or Ferrule: [Cast iron] [Stainless steel] <Insert material>.
8. Clamping Device: [Not required] [Required].
9. Outlet Connection: [Inside calk] [Spigot] [Threaded].
10. Closure: [Brass plug with straight threads and gasket] [Brass plug with tapered threads] [Cast-iron plug] [Plastic plug].
11. Adjustable Housing Material: [Cast iron] [Plastic] <Insert material> with [threads] [set-screws or other device].
12. Frame and Cover Material and Finish: [Nickel-bronze, copper alloy] [Painted cast iron] [Polished bronze] [Rough bronze] [Stainless steel] <Insert material and finish>.
13. Frame and Cover Shape: [Round] [Square] <Insert shape>.
14. Top Loading Classification: [Extra Heavy-] [Heavy] [Light] [Medium] Duty.
15. Riser: ASTM A 74, [Extra-Heavy] [Service] class, cast-iron drainage pipe fitting and riser to cleanout.
16. Standard: ASME A112.3.1.
17. Size: Same as connected branch.
18. Housing: Stainless steel.
19. Closure: Stainless steel with seal.
20. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts <Insert drawing designation if any>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. <Insert manufacturer's name.>
4. Standard: ASME A112.36.2M. Include wall access.

5. Size: Same as connected drainage piping.
6. Body: [Hub-and-spigot, cast-iron soil pipe T-branch] [Hubless, cast-iron soil pipe test tee] as required to match connected piping.
7. Closure: [Countersunk] [Countersunk or raised-head] [Raised-head], [drilled-and-threaded] [brass] [cast-iron] plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
9. Wall Access: Round, [deep, chrome-plated bronze] [flat, chrome-plated brass or stainless-steel] cover plate with screw.
10. Wall Access: [Round] [Square], [nickel-bronze, copper-alloy, or stainless-steel] <Insert material> wall-installation frame and cover.

2.2 GARAGE DRAINS

A. GARAGE Drains <Insert drawing designation if any>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
      g. <Insert manufacturer's name.>
   4. Standard: HD-20 Garage drains.
   5. Material: Ductile or gray iron.
   6. Flange: [Anchor] [Seepage] [Not required].
   7. Clamping Device: [Not required] [Required].
   8. Outlet: [Bottom] [End] [Side] <Insert location>.
   9. Grate Material: [Ductile iron] [Ductile iron or gray iron] [Gray iron] [Stainless steel] <Insert material>.
   10. Grate Finish: [Painted] [Not required] <Insert finish>.
   11. Dimensions of Frame and Grate: <Insert dimensions and describe body, sump, and grate if required.>
   12. Top Loading Classification: [Extra Heavy-Duty] [Heavy Duty] [Light Duty] [Medium Duty] <Delete if not applicable>.
   13. Trap Material: [Cast iron] [Stainless steel] [Not required] <Insert material>.
   14. Trap Pattern: [Standard P-trap] [Not required] <Insert pattern>.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies <Insert drawing designation if any>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ProSet Systems Inc.
   b. <Insert manufacturer's name.>
3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.4 ROOF DRAINS

A. Metal Roof Drains <Insert drawing designation if any>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Josam Company; Josam Div.
      b. LSP Products Group, Inc.
      c. Marathon Roofing Products.
      d. MIFAB, Inc.
      e. Olympic Manufacturing Group.
      f. Portals Plus, Inc.
      g. Prier Products, Inc.
      h. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      i. Thaler Metal Industries Ltd.
      j. Thunderbird Products.
      k. Tyler Pipe; Wade Div.
      l. Watts Drainage Products Inc.
      m. Zurn Plumbing Product
      n. Thunderbird Products.
      o. <Insert manufacturer's name.>
   4. Standard: ASME A112.21.2M.
   5. Pattern: [Balcony] [Canopy] [Cornice] [Promenade-deck] [Roof] [Scupper] <Insert pattern> drain.
   6. Body Material: [Aluminum] [Cast iron] [Copper] <Insert material>.
   7. Dimensions of Body: <Insert dimensions and describe body and sump if required.>
   8. Combination Flashing Ring and Gravel Stop: [Not required] [Required] <Insert other>.
   9. Flow-Control Weirs: [Not required] [Required].
   10. Outlet: [Bottom] [Side] [Angle] <Insert outlet>.

11. Dome Material: [Aluminum] [Cast iron] [PE] [Stainless steel] <Insert material>.
12. Extension Collars: [Not required] [Required].
13. Underdeck Clamp: [Not required] [Required].
14. Sump Receiver: [Not required] [Required].

2.5 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Expansion Joints <Insert drawing designation if any>:
1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected piping.

B. Downspout Boots <Insert drawing designation if any>:
1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout.
3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
4. Size: Same as or larger than connected downspout.

C. Conductor Nozzles <Insert drawing designation if any>:
1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.6 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm) thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install garage drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

F. Install through-penetration firestop assemblies in plastic [conductors] [and] [stacks] at floor penetrations.

G. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
   1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Position roof drains for easy access and maintenance.

H. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

I. 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.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. 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 (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:
   1. Faucets for [lavatories] [bathtubs] [bathtub/showers] [showers] [and] [sinks].
   2. Laminar-flow faucet-spout outlets.
   3. Flushometers.
   4. Toilet seats.
   5. Protective shielding guards.
   6. Fixture supports.
   7. Interceptors.
   8. Shower receptors.
   9. Dishwasher air-gap fittings.
   10. Disposers.
   11. Hot-water dispensers.
   12. Water closets.
   13. Urinals.
   14. Bidets.
   15. Lavatories.
   16. Commercial sinks.
   17. Shampoo bowls.
   18. Wash fountains.
   19. Bathtubs.
   20. Individual showers.
   21. Group showers.
   22. Whirlpool bathtubs.
   23. Kitchen sinks.
   24. Service sinks.
   25. Service basins.
   26. Laundry trays.
   27. Sacristy sinks.
   28. Owner-furnished fixtures.

B. Related Sections include the following:
   1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
   2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
   3. Division 22 Section "Domestic Water Filtration Equipment" for water filters.

4. Division 22 Section "Healthcare Plumbing Fixtures."
5. Division 22 Section "Emergency Plumbing Fixtures."
6. Division 22 Section "Security Plumbing Fixtures."
7. Division 22 Section "Drinking Fountains and Water Coolers."
8. Division 31 Section "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

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

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"[; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ;] for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Plastic Bathtubs: ANSI Z124.1.
   3. Plastic Lavatories: ANSI Z124.3.
   4. Plastic Laundry Trays: ANSI Z124.6.
   5. Plastic Mop-Service Basins: ANSI Z124.6.
   6. Plastic Shower Enclosures: ANSI Z124.2.
   7. Plastic Sinks: ANSI Z124.6.
   8. Plastic Urinal Fixtures: ANSI Z124.9.
   9. Plastic Whirlpool Bathtubs: ANSI Z124.1 and ASME A112.19.7M.
   10. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   11. Slip-Resistant Bathing Surfaces: ASTM F 462.
   12. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
   13. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
   14. Stainless-Steel Residential Sinks: ASME A112.19.3.
   15. Vitreous-China Fixtures: ASME A112.19.2M.
   16. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
   17. Water-Closet, Flushometer Tank Trim: ASSE 1037.
   18. Whirlpool Bathtub Fittings: ASME A112.19.8M.

H. Comply with the following applicable standards and other requirements specified for [lavatory] [and] [sink] faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
   4. Faucets: ASME A112.18.1.
   5. Hose-Connection Vacuum Breakers: ASSE 1011.
   6. Hose-Coupling Threads: ASME B1.20.7.
   7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   8. NSF Potable-Water Materials: NSF 61.
   9. Pipe Threads: ASME B1.20.1.
   10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   11. Supply Fittings: ASME A112.18.1.
   12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for [bathtub] [bathtub/shower] [and] [shower] faucets:
   1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.

2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Hot-Water Dispensers: ASSE 1023 and UL 499.
8. Off-Floor Fixture Supports: ASME A112.6.1M.
9. Pipe Threads: ASME B1.20.1.
10. Plastic Shower Receptors: ANSI Z124.2.
11. Plastic Toilet Seats: ANSI Z124.5.
12. Supply and Drain Protective Shielding Guards: ICC A117.1.
13. Whirlpool Bathtub Equipment: UL 1795.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures of unit shell.
b. Faulty operation of controls, blowers, pumps, heaters, and timers.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: [One] [Three] <Insert number> year(s) from date of Substantial Completion.

3. Warranty Period for Residential Applications of Shells: [Five] [20] [30] <Insert number> years from date of Substantial Completion.
4. Warranty Period for Residential Applications of Pumps and Blowers: [Five] [20] <Insert number> years from date of Substantial Completion.
5. Warranty Period for Residential Applications of Electronic Controls: [Five] <Insert number> years from date of Substantial Completion.

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. Faucet Washers and O-Rings: Equal to [10] <Insert number> percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to [5] <Insert number> percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to [10] <Insert number> percent of amount of each type installed, but no fewer than [12] <Insert number> of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Flushometer Tank, Repair Kits: Equal to [5] <Insert number> percent of amount of each type installed, but no fewer than [2] <Insert number> of each type.
6. Water-Closet Tank, Repair Kits: Equal to [5] <Insert number> percent of amount of each type installed.
7. Toilet Seats: Equal to [5] <Insert number> percent of amount of each type installed.
8. Dry Urinal Trap-Seal Cartridges: Equal to [200] <Insert number> percent of amount of each type installed, but no fewer than [12] <Insert number> of each type.
9. Dry Urinal Trap-Seal Liquid: Equal to [1 gal (3.8 L)] <Insert volume> for each urinal installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Bradley Corporation.
   c. Chicago Faucets.
   d. Delta Faucet Company.

e. Eljer.
f. Elkay Manufacturing Co.
g. Fisher Manufacturing Co.
h. Grohe America, Inc.
i. Just Manufacturing Company.
j. Kohler Co.
k. Moen, Inc.
l. Royal Brass Mfg. Co.
m. Sayco; a Briggs Plumbing Products, Inc. Company.
n. Speakman Company.
o. T & S Brass and Bronze Works, Inc.
p. Zurn Plumbing Products Group; Commercial Brass Operation.
q. <Insert manufacturer's name.>
r. American Standard Companies, Inc.
s. Bradley Corporation.
t. Brasstech Inc.; Newport Brass Div.
u. Broadway Collection.
v. Central Brass Manufacturing Company.
w. Chicago Faucets.
x. Delta Faucet Company.
y. Eljer.
z. Elkay Manufacturing Co.
aa. Fisher Manufacturing Co.
bb. Franke Consumer Products, Inc.; Kitchen Systems Div.
cc. Gerber Plumbing Fixtures LLC.
dd. Geberit Manufacturing, Inc.
ee. Grohe America, Inc.
ff. Hansgrohe Inc.
gg. Hydrotek International, Inc.
hh. Intersan Manufacturing Company.
ii. Just Manufacturing Company.
jj. Kohler Co.
kk. Moen, Inc.
ll. Pegler, Ltd.
mm. Price Pfister, Inc.
nn. Rohl LLC.
oo. Royal Brass Mfg. Co.
pp. Sayco; a Briggs Plumbing Products, Inc. Company.
qq. Speakman Company.
rr. T & S Brass and Bronze Works, Inc.
ss. Water Management, Inc.
tt. Wolverine Brass, Inc.
uu. Zurn Plumbing Products Group; Commercial Brass Operation.
vv. <Insert manufacturer's name.>
ww. American Standard Companies, Inc.
xx. Bradley Corporation.
yy. Brasstech Inc.; Newport Brass Div.
zz. Broadway Collection.
aaa. Central Brass Manufacturing Company.
bbb. Chicago Faucets.
ccc. Delta Faucet Company.
ddd. Eljer.

eee. Elkay Manufacturing Co.
fff. Fisher Manufacturing Co.
ggg. Franke Consumer Products, Inc.; Kitchen Systems Div.
hhh. Gerber Plumbing Fixtures LLC.
iii. Geberit Manufacturing, Inc.
jjj. Grohe America, Inc.
kkk. Hansgrohe Inc.
lll. Hydrotek International, Inc.
mmm. Intersan Manufacturing Company.
nnn. Just Manufacturing Company.
ooo. Kohler Co.
ppp. Moen, Inc.
qqq. Paul Decorative Products.
rrr. Pegler, Ltd.
sss. Phoenix Products, Inc.
ttt. Price Pfister, Inc.
uuu. Rohl LLC.
vvv. Royal Brass Mfg. Co.
www. Sayco; a Briggs Plumbing Products, Inc. Company.
xxx. Sterling Plumbing Group, Inc.
yyy. St. Thomas Creations.
zzz. Speakman Company.
aaaa. Symmons Industries, Inc.
bbbb. T & S Brass and Bronze Works, Inc.
cccc. Water Management, Inc.
dddd. WhiteRock Corp.
eeee. Wolverine Brass, Inc.
ffff. Zurn Plumbing Products Group; Commercial Brass Operation.
gggg. <Insert manufacturer's name.>
hhhh. American Standard Companies, Inc.
iiii. Delta Faucet Company.
jjjj. Eljer.
kkkk. Gerber Plumbing Fixtures LLC.
llll. Moen, Inc.
mmmm. Phoenix Products, Inc.
nnnn. Sayco; a Briggs Plumbing Products, Inc. Company.
oooo. Sterling Plumbing Group, Inc.
pppp. WhiteRock Corp.
qqqq. Wolverine Brass, Inc.
rrrr. <Insert manufacturer's name.>
ssss. Gerber Plumbing Fixtures LLC.
tttt. Phoenix Products, Inc.
uuuu. Sterling Plumbing Group, Inc.
vvvv. Zurn Plumbing Products Group; Wilkins Operation.
wwww. <Insert manufacturer's name.>

4. Description: [Single-control mixing] [Single-control nonmixing] [Two-handle mixing] <Insert type> valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   a. Body Material: [Commercial, solid brass] [General-duty, solid brass] [General-duty, solid brass or copper or brass underbody with brass cover plate] [General-duty, copper or brass underbody with brass cover

plate] [Residential, nonmetallic underbody with brass cover plate] [Residential, nonmetallic underbody with nonmetallic cover plate].
b. Finish: [Polished chrome plate] [Polished brass] [Nonmetallic].
c. Maximum Flow Rate: [0.5 gpm (1.5 L/min.)] [2.2 gpm (8.3 L/min.)] [2.5 gpm (9.5 L/min.)] <Insert value>.
d. Maximum Flow: [0.25 gal. (0.95 L)] <Insert amount>.
e. Centers: [3-3/8 inches (86 mm)] [4 inches (102 mm)] [6 inches (152 mm)] [8 inches (203 mm)] [Single hole] [Adjustable].
f. Mounting: [Deck, exposed] [Deck, concealed] [Back/wall, exposed] [Back/wall, concealed].
g. Valve Handle(s): [Lever] [Knob] [Knob, nonmetallic] [Cross, four arm] [Wrist blade, 4 inches (102 mm)] [Elbow, 6 inches (152 mm)] [Push button] [Not applicable].
h. Inlet(s): [NPS 3/8 (DN 10) tubing, plain end] [NPS 3/8 (DN 10) tubing, with NPS 1/2 (DN 15) male adaptor] [NPS 1/2 (DN 15) male shank] [NPS 1/2 (DN 15) female shank].
i. Spout: [Rigid] [Swing] [Rigid, gooseneck] [Swivel, gooseneck] type.
j. Spout Outlet: [Aerator] [Spray] [Laminar flow] [Plain end] [Spray, 0.5 gpm (1.5 L/min.)].
k. Operation: [Compression, manual] [Noncompression, manual] [Sensor] [Self-closing, metering].
l. Drain: [Not required] [Pop up] [Stopper with chain] [Grid] [Lift and turn].
m. Tempering Device: [Mechanical] [Thermostatic] [Pressure balance] [Not required].

2.2 BATHTUB FAUCETS

A. Bathtub Faucets, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. American Standard Companies, Inc.
b. Brasstech Inc.; Newport Brass Div.
c. Broadway Collection.
d. Central Brass Manufacturing Company.
e. Delta Faucet Company.
f. Eljer.
g. Gerber Plumbing Fixtures LLC.
h. Grohe America, Inc.
i. Hansgrohe Inc.
j. Kohler Co.
k. Moen, Inc.
l. Paul Decorative Products.
m. Pegler, Ltd.
n. Powers; a Watts Industries Co.
o. Royal Brass Mfg. Co.

p. Sayco; a Briggs Plumbing Products, Inc. Company.
q. Speakman Company.
r. Sterling Plumbing Group, Inc.
s. St. Thomas Creations.
t. Symmons Industries, Inc.
u. T & S Brass and Bronze Works, Inc.
v. Wolverine Brass, Inc.
w. <Insert manufacturer's name.>

4. Description: [Single-control mixing] [Two-handle mixing] [Three-handle mixing] [Push-button, metering, nonmixing] <Insert type> valve. Include hot- and cold-water indicators and tub spout. Coordinate faucet inlets with supplies.
   a. Body Material: [Solid brass] <Insert material>.
   b. Finish: [Polished chrome plate] [Polished brass] <Insert finish>.
   c. Mounting: [Deck] [Exposed, over rim] [Wall] <Insert mounting>.
   d. Valve Handle(s): [Lever] [Knob] [Knob, nonmetallic] [Cross, four arm] [Not applicable] <Insert handle(s)>.
   e. Bathtub Spout: [Chrome-plated brass] <Insert material>[with diverter].
   f. Operation: [Compression, manual] [Noncompression, manual] [Sensor] <Insert operation>.
   g. Supply Connections: [NPS 1/2 (DN 15)] [NPS 1/2 (DN 15), union] [Sweat].

2.3 BATHTUB/SHOWER FAUCETS

A. Bathtub/Shower Faucets, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. American Standard Companies, Inc.
      b. Brasstech Inc.; Newport Brass Div.
      c. Broadway Collection.
      d. Central Brass Manufacturing Company.
      e. Chicago Faucets.
      f. Delta Faucet Company.
      g. Eljer.
      h. Gerber Plumbing Fixtures LLC.
      i. Hansgrohe Inc.
      j. Kohler Co.
      k. Leonard Valve Company.
      l. Moen, Inc.
      m. Paul Decorative Products.
      n. Pegler, Ltd.
      o. Powers; a Watts Industries Co.
      p. Price Pfister, Inc.
      q. Rohl LLC.

r. Royal Brass Mfg. Co.
s. Sayco; a Briggs Plumbing Products, Inc. Company.
t. Speakman Company.
u. Sterling Plumbing Group, Inc.
v. St. Thomas Creations.
w. Symmons Industries, Inc.
x. T & S Brass and Bronze Works, Inc.
y. Wolverine Brass, Inc.
z. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.
aa. Zurn Plumbing Products Group; Wilkins Operation.
bb. <Insert manufacturer's name.>
cc. Broadway Collection.
dd. Hansgrohe Inc.
ee. Leonard Valve Company.
ff. Powers; a Watts Industries Co.
gg. T & S Brass and Bronze Works, Inc.
hh. <Insert manufacturer's name.>
ii. Chicago Faucets.
jj. Grohe America, Inc.
kk. Lawler Manufacturing Co., Inc.
ll. T & S Brass and Bronze Works, Inc.
mm. <Insert manufacturer's name.>

4. Description: Single-handle [pressure-balance] [thermostatic] [thermostatic/pressure-balance] <Insert type> valve for bathtub and for shower. Include hot- and cold-water indicators; check stops; tub spout; and shower head, arm, and flange. Coordinate faucet inlets with supplies; coordinate outlet with diverter valve.
   a. Body Material: [Solid brass] <Insert material>[with nonmetallic trim].
   b. Finish: [Polished chrome plate] [Polished brass] <Insert finish>.
   c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
   d. Diverter Valve: [Integral] [Not integral] with mixing valve.
   e. Mounting: [Wall] <Insert mounting>.
   f. Bathtub Spout: [Chrome-plated brass] <Insert material>[with diverter].
   g. Operation: [Compression, manual] [Noncompression, manual] [Sensor] <Insert operation>.
   h. Antiscald Device: [Integral with mixing valve] [Separate unit].
   i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   j. Supply Connections: [NPS 1/2 (DN 15)] [NPS 1/2 (DN 15), union] [Sweat].
   k. Backflow Protection Device for Hand-Held Shower: [Required] [Not required].
   l. Shower Head Type: [Ball joint] [Without ball joint] [Ball joint and head integral with mounting flange] [Integral with mounting flange] [Hand held, slide-bar mounted] [Hand held, hook mounted].
   m. Shower Head Material: [Metallic] [Nonmetallic] [Combined, metallic and nonmetallic] with chrome-plated finish.
   n. Spray Pattern: [Fixed] [Adjustable].
   o. Integral Volume Control: [Required] [Not required].

p. Shower-Arm Flow-Control Fitting: [Not required] [1.5 gpm (5.7 L/min.)] [2.0 gpm (7.6 L/min.)].

2.4 SHOWER FAUCETS

A. Shower Faucets, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Brasstech Inc.; Newport Brass Div.
   c. Broadway Collection.
   d. Central Brass Manufacturing Company.
   e. Chicago Faucets.
   f. Delta Faucet Company.
   g. Eljer.
   h. Gerber Plumbing Fixtures LLC.
   i. Hansgrohe Inc.
   j. Kohler Co.
   k. Leonard Valve Company.
   l. Moen, Inc.
   m. Paul Decorative Products.
   n. Pegler, Ltd.
   o. Powers; a Watts Industries Co.
   p. Price Pfister, Inc.
   q. Rohl LLC.
   r. Royal Brass Mfg. Co.
   s. Sayco; a Briggs Plumbing Products, Inc. Company.
   t. Speakman Company.
   u. Sterling Plumbing Group, Inc.
   v. St. Thomas Creations.
   w. Symmons Industries, Inc.
   x. T & S Brass and Bronze Works, Inc.
   y. Wolverine Brass, Inc.
   z. Zurn Plumbing Products Group; AquaSpec Commercial Faucet Operation.
   aa. Zurn Plumbing Products Group; Wilkins Operation.
   bb. <Insert manufacturer's name.>
   cc. Broadway Collection.
   dd. Hansgrohe Inc.
   ee. Leonard Valve Company.
   ff. Powers; a Watts Industries Co.
   gg. T & S Brass and Bronze Works, Inc.
   hh. <Insert manufacturer's name.>
   ii. Chicago Faucets.
   jj. Grohe America, Inc.
   kk. Lawler Manufacturing Co., Inc.

ll. T & S Brass and Bronze Works, Inc.
mm. <Insert manufacturer's name.>

4. Description: Single-handle [pressure-balance] [thermostatic] [thermostatic and pressure-balance] valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
   a. Body Material: [Solid brass] <Insert material>[with nonmetallic trim].
   b. Finish: [Polished chrome plate] [Polished brass] <Insert finish>.
   c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
   d. Diverter Valve: [Not required] [Integral with mixing valve] [Not integral with mixing valve].
   e. Mounting: [Exposed] [Concealed].
   f. Backflow Protection Device for Hand-Held Shower: [Required] [Not required].
   g. Operation: [Compression, manual] [Noncompression, manual] [Sensor].
   h. Antiscald Device: [Integral with mixing valve] [Separate unit] [Not required].
   i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   j. Supply Connections: [NPS 1/2 (DN 15)] [NPS 1/2 (DN 15), union] [Sweat].
   k. Shower Head Type: [Ball joint] [Without ball joint] [Ball joint and head integral with mounting flange] [Integral with mounting flange] [Hand held, slide-bar mounted] [Hand held, hook mounted].
   l. Shower Head Material: [Metallic] [Nonmetallic] [Combined, metallic and nonmetallic] with chrome-plated finish.
   m. Spray Pattern: [Fixed] [Adjustable].
   n. Integral Volume Control: [Required] [Not required].
   o. Shower-Arm Flow-Control Fitting: [Not required] [1.5 gpm (5.7 L/min.)] [2.0 gpm (7.6 L/min.)].
   p. Temperature Indicator: [Not required] [Integral with faucet].

2.5 SINK FAUCETS

A. Sink Faucets, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. American Standard Companies, Inc.
      b. Bradley Corporation.
      c. Broadway Collection.
      d. Chicago Faucets.
      e. Delta Faucet Company.
      f. Dormont Manufacturing Company.
      g. Eljer.
      h. Elkay Manufacturing Co.

i. Fisher Manufacturing Co.
j. Grohe America, Inc.
k. Just Manufacturing Company.
l. Kohler Co.
m. Moen, Inc.
n. Royal Brass Mfg. Co.
o. Sayco; a Briggs Plumbing Products, Inc. Company.
p. Speakman Company.
q. T & S Brass and Bronze Works, Inc.
r. Zurn Plumbing Products Group; Commercial Brass Operation.
s. <Insert manufacturer's name.>
t. American Standard Companies, Inc.
u. Bradley Corporation.
v. Brasstech Inc.; Newport Brass Div.
w. Broadway Collection.
x. Central Brass Manufacturing Company.
y. Chicago Faucets.
z. Delta Faucet Company.
aa. Eljer.
bb. Elkay Manufacturing Co.
cc. Fisher Manufacturing Co.
dd. Franke Consumer Products, Inc.; Kitchen Systems Div.
ee. Gerber Plumbing Fixtures LLC.
ff. Grohe America, Inc.
gg. Hansgrohe Inc.
hh. Hydrotek International, Inc.
ii. Intersan Manufacturing Company.
jj. Just Manufacturing Company.
kk. Kohler Co.
ll. Moen, Inc.
mm. Pegler, Ltd.
nn. Price Pfister, Inc.
oo. Rohl LLC.
pp. Royal Brass Mfg. Co.
qq. Sayco; a Briggs Plumbing Products, Inc. Company.
rr. Speakman Company.
ss. T & S Brass and Bronze Works, Inc.
tt. Water Management, Inc.
uu. Wolverine Brass, Inc.
vv. Zurn Plumbing Products Group; Commercial Brass Operation.
ww. <Insert manufacturer's name.>
xx. American Standard Companies, Inc.
yy. Bradley Corporation.
zz. Brasstech Inc.; Newport Brass Div.
aaa. Central Brass Manufacturing Company.
bbb. Chicago Faucets.
ccc. Delta Faucet Company.
ddd. Eljer.
eee. Elkay Manufacturing Co.
fff. Fisher Manufacturing Co.
ggg. Franke Consumer Products, Inc.; Kitchen Systems Div.
hhh. Gerber Plumbing Fixtures LLC.

iii. Grohe America, Inc.
jjj. Hansgrohe Inc.
kkk. Hydrotek International, Inc.
lll. Intersan Manufacturing Company.
mmm. Just Manufacturing Company.
nnn. Kohler Co.
ooo. Moen, Inc.
ppp. Paul Decorative Products.
qqq. Pegler, Ltd.
rrr. Phoenix Products, Inc.
sss. Price Pfister, Inc.
ttt. Rohl LLC.
uuu. Royal Brass Mfg. Co.
vvv. Sayco; a Briggs Plumbing Products, Inc. Company.
www. Sterling Plumbing Group, Inc.
xxx. St. Thomas Creations.
yyy. Speakman Company.
zzz. Symmons Industries, Inc.
aaaa. T & S Brass and Bronze Works, Inc.
bbbb. Water Management, Inc.
cccc. WhiteRock Corp.
dddd. Wolverine Brass, Inc.
eeee. Zurn Plumbing Products Group; Commercial Brass Operation.
ffff. <Insert manufacturer's name.>
gggg. American Standard Companies, Inc.
hhhh. Delta Faucet Company.
iiii. Eljer.
jjjj. Moen, Inc.
kkkk. Phoenix Products, Inc.
llll. Sayco; a Briggs Plumbing Products, Inc. Company.
mmmm. Sterling Plumbing Group, Inc.
nnnn. WhiteRock Corp.
oooo. Wolverine Brass, Inc.
pppp. <Insert manufacturer's name.>
qqqq. Gerber Plumbing Fixtures LLC.
rrrr. Sterling Plumbing Group, Inc.
ssss. Zurn Plumbing Products Group; Wilkins Operation.
tttt. <Insert manufacturer's name.>

4. Description: [Kitchen faucet with spray, three-hole fixture] [Kitchen faucet with spray, four-hole fixture] [Kitchen faucet without spray] [Laundry tray faucet] [Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook] [Bar sink faucet] <Insert type>. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   a. Body Material: [Commercial, solid brass] [General-duty, solid brass] [General-duty, solid brass or copper or brass underbody with brass cover plate] [General-duty, copper or brass underbody with brass cover plate] [Residential, nonmetallic underbody with brass cover plate] [Residential, nonmetallic underbody with nonmetallic cover plate] <Insert material>.
   b. Finish: [Polished chrome plate] [Polished brass] [Nonmetallic] [Polished or rough brass] [Rough brass] <Insert finish>.

c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
d. Mixing Valve: [Single control] [Two-lever handle].
e. Backflow Protection Device for Hose Outlet: [Required] [Not required].
f. Backflow Protection Device for Side Spray: [Required] [Not required].
g. Centers: [3-3/8 inches (86 mm)] [4 inches (102 mm)] [6 inches (152 mm)] [8 inches (203 mm)] [Single hole] [Adjustable].
h. Mounting: [Deck] [Back/wall], [exposed] [concealed].
i. Handle(s): [Lever] [Knob] [Knob, nonmetallic] [Cross, four arm] [Wrist blade, 4 inches (102 mm)] [Elbow, 6 inches (152 mm)] [Not applicable].
j. Inlet(s): [NPS 3/8 (DN 10) plain-end tubing] [NPS 3/8 (DN 10) tubing with NPS 1/2 (DN 15) male adapter] [NPS 1/2 (DN 15) male shank] [NPS 1/2 (DN 15) female shank].
k. Spout Type: [Rigid, solid brass] [Rigid, solid brass with wall brace] [Swing, round tubular] [Swing, shaped tube] [Swing, solid brass] [Rigid gooseneck] [Swivel gooseneck].
l. Spout Outlet: [Aerator] [Swivel aerator/spray] [Spray] [Laminar flow] [Hose thread] [Plain end].
m. Vacuum Breaker: [Required] [Not required].
n. Operation: [Compression, manual] [Noncompression, manual] [Sensor].
o. Drain: [Not required] [Pop up] [Stopper with chain] [Grid] [Lift and turn].

2.6 LAMINAR-FLOW FAUCET-SPOUT OUTLETS

A. Laminar-Flow Faucet-Spout Outlets, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Chronomite Laboratories, Inc.
b. NEOPERL, Inc.
c. <Insert manufacturer's name.>
4. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating, laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.7 FLUSHOMETERS

A. Flushometers, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Coyne & Delany Co.
   b. Delta Faucet Company.
   c. Sloan Valve Company.
   d. Zurn Plumbing Products Group; Commercial Brass Operation.
   e. <Insert manufacturer's name.>
   f. Hydrotek International, Inc.
   g. Sloan Valve Company.
   h. TOTO USA, Inc.
   i. <Insert manufacturer's name.>
   j. Coyne & Delany Co.
   k. Delta Faucet Company.
   l. Hydrotek International, Inc.
   m. Sloan Valve Company.
   n. TOTO USA, Inc.
   o. Zurn Plumbing Products Group; Commercial Brass Operation.
   p. <Insert manufacturer's name.>
4. Description: Flushometer for [urinal] [water-closet]-type fixture. Include brass body with corrosion-resistant internal components,[non-hold-open feature,] control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
   a. Internal Design: [Diaphragm] [or] [piston] operation.
   b. Style: [Exposed] [Concealed].
   c. Inlet Size: [NPS 3/4 (DN 20)] [NPS 1 (DN 25)].
   d. Trip Mechanism: [Oscillating, lever-handle actuator] [Mechanical, push-button actuator with stainless-steel access plate] [Hydraulic, push-button actuator] [Foot-pedal actuator] [Hard-wired, electric-sensor actuator] [Battery-operated sensor actuator] <Insert type>.
   e. Consumption: [0.5 gal./flush (1.9 L/flush)] [1.0 gal./flush (3.8 L/flush)] [1.5 gal./flush (5.7 L/flush)] [1.6 gal./flush (6.0 L/flush)] [3.5 gal./flush (13.3 L/flush)] <Insert rate>.
   f. Tailpiece Size: [NPS 3/4 (DN 20)] [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)] <Insert size> and [standard] <Insert dimension> length to top of bowl.

2.8 TOILET SEATS

A. Toilet Seats, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. American Standard Companies, Inc.
      b. Bemis Manufacturing Company.
      c. Centoco Manufacturing Corp.
      d. Church Seats.

e. Eljer.
f. Kohler Co.
g. Olsonite Corp.
h. Sanderson Plumbing Products, Inc.; Beneke Div.
i. Sperzel.
j. <Insert manufacturer's name.>
k. Bemis Manufacturing Company.
l. Centoco Manufacturing Corp.
m. Church Seats.
n. Kohler Co.
o. Olsonite Corp.
p. Pressalit A/S.
q. Sanderson Plumbing Products, Inc.; Beneke Div.
r. Sperzel.
s. <Insert manufacturer's name.>

4. Description: Toilet seat for water-closet-type fixture.
   a. Material: Molded, solid plastic[with antimicrobial agent].
   b. Configuration: [Closed] [Open] front [with] [without] cover.
   c. Size: [Elongated] [Regular].
   d. Hinge Type: [CK, check] [SS, self-sustaining] [SC, self-sustaining, check] [SR, self-raising] <Insert type>.
   e. Class: [Residential] [Standard commercial] [Heavy-duty commercial].
   f. Color: [White] [Black] <Insert color>.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Engineered Brass Co.
      b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
      c. McGuire Manufacturing Co., Inc.
      d. Plumberex Specialty Products Inc.
      e. TCI Products.
      f. TRUEBRO, Inc.
      g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
      h. <Insert manufacturer's name.>
   3. Description: Manufactured plastic wraps for covering plumbing fixture [hot-water supply] [hot- and cold-water supplies] and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. TRUEBRO, Inc.
      b. <Insert manufacturer's name.>

3. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.10 FIXTURE SUPPORTS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. <Insert manufacturer's name.>

C. Water-Closet Supports, <Insert drawing designation>:
1. Description: Combination carrier designed for [accessible] [standard] mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports, <Insert drawing designation>:
1. Description: Type [I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture] [II, urinal carrier with hanger and bearing plates] for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports, <Insert drawing designation>:
1. Description: Type [I, lavatory carrier with exposed arms and tie rods] [II, lavatory carrier with concealed arms and tie rod] [III, lavatory carrier with hanger plate and tie rod] for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

F. Sink Supports, <Insert drawing designation>:
1. Description: Type [I, sink carrier with exposed arms and tie rods] [II, sink carrier with hanger plate, bearing studs, and tie rod] [III, sink carrier with hanger plate and exposed arms] for sink-type fixture. Include steel uprights with feet.

2.11 INTERCEPTORS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company.
   2. MIFAB Manufacturing Inc.
   3. Smith, Jay R. Mfg. Co.
   4. Tyler Pipe; Wade Div.
   5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
   6. Zurn Plumbing Products Group; Specification Drainage Operation.
   7. <Insert manufacturer's name.>

C. Hair Interceptors, <Insert drawing designation>:
   1. Description: Manufactured unit with removable screen or strainer and removable cover; designed to trap and retain hair.
      a. Material: [Brass] [or] [stainless-steel] body.
      b. Pipe Connections: [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)].

D. Sediment Interceptors, <Insert drawing designation>:
   1. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
      a. Material: [Cast-iron or steel body with acid-resistant lining and coating] [or] [carbon-steel body with acid-resistant lining and coating] [stainless-steel].
      b. Pipe Connections: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)].

2.12 SHOWER RECEPTORS

A. Shower Receptors, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Crane Plumbing, L.L.C./Fiat Products.
      b. Florestone Products Co., Inc.
      c. <Insert manufacturer's name.>
      d. Aker Plastics Co., Inc.
      e. Crane Plumbing, L.L.C./Fiat Products.
      f. Florestone Products Co., Inc.
      g. LASCO Bathware.
      h. Mustee, E. L. & Sons, Inc.
      i. Sterling Plumbing Group, Inc.
      j. Swan Corporation (The).
      k. <Insert manufacturer's name.>
      l. Acryline USA, Inc.
      m. American Standard Companies, Inc.
      n. Florestone Products Co., Inc.
      o. Jacuzzi, Inc.
      p. Jason International, Inc.
      q. Kohler Co.
      r. LASCO Bathware.

s. Praxis Industries, Inc.; Aquarius Products.
t. Royal Baths Manufacturing Co.
u. <Insert manufacturer's name.>
v. Acorn Engineering Company.
w. Crane Plumbing, L.L.C./Fiat Products.
x. Florestone Products Co., Inc.
y. Precast Terrazzo Enterprises, Inc.
z. Stern-Williams Co., Inc.
aa. <Insert manufacturer's name.>
bb. Bradley Corporation.
cc. Formica Corporation.
dd. Jacuzzi, Inc.
ee. Lippert Corporation.
ff. Swan Corporation (The).
gg. <Insert manufacturer's name.>

4. Description: [Cast-polymer] [FRP] [PMMA] [Precast-terrazzo] [Solid-surface] base for built-up-type shower fixture.
   a. Type: [Standard, residential] [Handicapped/wheelchair].
   b. Size: [32 by 32 inches (813 by 813 mm)] [36 by 36 inches (914 by 914 mm)] [32 by 42 inches (813 by 1067 mm)] [48 by 60 inches (1219 by 1524 mm)] <Insert dimensions>.
   c. Color: [White] <Insert color>.
   d. Outlet: [Cast-in-floor drain] [Drain] with [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] [NPS 3 (DN 80)] outlet.

2.13 DISHWASHER AIR-GAP FITTINGS

A. Dishwasher Air-Gap Fittings, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B & K Industries, Inc.
      b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
      c. Brasstech Inc.; Newport Brass Div.
      d. Dearborn Brass; a div. of Moen, Inc.
      e. Geberit Manufacturing, Inc.
      f. JB Products; a Federal Process Corporation Company.
      g. Sioux Chief Manufacturing Company, Inc.
      h. Watts Brass & Tubular; a division of Watts Regulator Co.
      i. <Insert manufacturer's name.>
   3. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body[, chrome-plated brass cover]; and capacity of at least 5 gpm (0.32 L/s); and inlet pressure of at least 5 psig (35 kPa) at a temperature of at least 140 deg F (60 deg C). Include 5/8-inch- (16-mm-) ID inlet and 7/8-inch- (22-mm-) ID outlet hose connections.
   4. Hoses: Rubber and suitable for temperature of at least 140 deg F (60 deg C).
      a. Inlet Hose: 5/8-inch (16-mm) ID and [48 inches (1219 mm)] <Insert length> long.
      b. Outlet Hose: 7/8-inch (22-mm) ID and [48 inches (1219 mm)] <Insert length> long.

2.14 DISPOSERS

A. Disposers, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. American Standard Companies, Inc.
      b. Franke Consumer Products, Inc.; Kitchen Systems Div.
      c. In-Sink-Erator; a div. of Emerson Electric Co.
      d. KitchenAid.
      e. Maytag Co.
      f. <Insert manufacturer's name.>
      g. American Standard Companies, Inc.
      h. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.
      i. Franke Consumer Products, Inc.; Kitchen Systems Div.
      j. In-Sink-Erator; a div. of Emerson Electric Co.
      k. KitchenAid.
      l. Maytag Co.
      m. WhiteRock Corp.
      n. <Insert manufacturer's name.>
   4. Description: [Batch] [Continuous]-feed household, food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 (DN 40) outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
      a. Type: [Batch] [Continuous]-feed household.
      b. Model: [Not applicable] [Sound-insulated chamber] [Sound-insulated chamber and stainless-steel outer shell].
      c. Motor: 115-V ac, 1725 rpm, [1/3] [1/2] [3/4] [1] hp with overload protection.

2.15 HOT-WATER DISPENSERS

A. Hot-Water Dispensers, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.
      b. Franke Consumer Products, Inc.; Kitchen Systems Div.
      c. In-Sink-Erator; a div. of Emerson Electric Co.
      d. Just Manufacturing Company.
      e. <Insert manufacturer's name.>
      f. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.

g. Elkay Manufacturing Co.
h. In-Sink-Erator; a div. of Emerson Electric Co.
i. Just Manufacturing Company.
j. KitchenAid.
k. <Insert manufacturer's name.>

4. Description: [Gooseneck spout with lever-handle] [Spout with twist-knob or push-button], flow control, household-type dispenser with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric heating element; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to 190 deg F (88 deg C); and thermal-overload protection.
   a. Storage Tank Capacity: 0.5 gal. (1.5 L).
   b. Heating Element: 750 W minimum, 115-V ac.

2.16 WATER CLOSETS

A. Water Closets, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Crane Plumbing, L.L.C./Fiat Products.
      b. <Insert manufacturer's name.>
      c. American Standard Companies, Inc.
      d. <Insert manufacturer's name.>
      e. American Standard Companies, Inc.
      f. Briggs Plumbing Products, Inc.
      g. Capizzi.
      h. Crane Plumbing, L.L.C./Fiat Products.
      i. Eljer.
      j. Kohler Co.
      k. St. Thomas Creations.
      l. TOTO USA, Inc.
      m. <Insert manufacturer's name.>
      n. American Standard Companies, Inc.
      o. Crane Plumbing, L.L.C./Fiat Products.
      p. Eljer.
      q. Kohler Co.
      r. <Insert manufacturer's name.>
   4. Description [Accessible, wall] [Wall]-mounting, back-outlet, vitreous-china fixture designed for [flushometer-tank] [gravity-type tank] [flushometer valve] operation.
      a. Style: [Close coupled] [One piece].
         1) Bowl Type: [Elongated] [Round front] with siphon-jet design.
         2) Design Consumption: [1.6 gal./flush (6 L/flush)] [3.5 gal./flush (13.3 L/flush)].
         3) Tank: [Gravity type with trim] [Flushometer-tank type with trim and pressurized tank]. Include cover.

4) Trip Mechanism: [Lever-handle] [Push-button] <Insert type> actuator.
5) Color: [White] <Insert color>.

b. Supply: [NPS 1/2 (DN 15)] <Insert size> chrome-plated brass or copper with [wheel-handle] [screwdriver] [loose-key] <Insert type> stop.
c. Style: Flushometer valve.
1) Bowl Type: [Elongated] [Round front] with [siphon-jet] [blowout] design.
2) Design Consumption: [1.6 gal./flush (6 L/flush)] [3.5 gal./flush (13.3 L/flush)] <Insert rate>.
3) Color: [White] <Insert color>.
d. Flushometer: <Insert designation.>
e. Toilet Seat: <Insert designation.>
f. Fixture Support: Water-closet support <Insert designation> combination carrier.

B. Water Closets, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. American Standard Companies, Inc.
b. Barclay Products, Ltd.
c. Briggs Plumbing Products, Inc.
d. Crane Plumbing, L.L.C./Fiat Products.
e. Duravit USA, Inc.
f. Eljer.
g. Gerber Plumbing Fixtures LLC.
h. Kohler Co.
i. Mansfield Plumbing Products, Inc.
j. Peerless Pottery, Inc.
k. Sanitarios Azteca, S.A. de C.V.
l. Sterling Plumbing Group, Inc.
m. St. Thomas Creations.
n. TOTO USA, Inc.
o. Water Management, Inc.
p. <Insert manufacturer's name.>
q. Capizzi.
r. St. Thomas Creations.
s. <Insert manufacturer's name.>
t. American Standard Companies, Inc.
u. Gerber Plumbing Fixtures LLC.
v. Kohler Co.
w. Mansfield Plumbing Products, Inc.
x. St. Thomas Creations.
y. <Insert manufacturer's name.>
z. Crane Plumbing, L.L.C./Fiat Products.
aa. Eljer.

bb. Peerless Pottery, Inc.
cc. Water Management, Inc.
dd. <Insert manufacturer's name.>
ee. Briggs Plumbing Products, Inc.
ff. <Insert manufacturer's name.>
gg. American Standard Companies, Inc.
hh. Briggs Plumbing Products, Inc.
ii. Capizzi.
jj. Crane Plumbing, L.L.C./Fiat Products.
kk. Eljer.
ll. Kohler Co.
mm. Mansfield Plumbing Products, Inc.
nn. Peerless Pottery, Inc.
oo. Sanitarios Azteca, S.A. de C.V.
pp. St. Thomas Creations.
qq. TOTO USA, Inc.
rr. <Insert manufacturer's name.>

4. Description: [Accessible, floor] [Floor]-mounting, floor-outlet, vitreous-china fixture designed for [gravity-type tank] [flushometer tank] [flushometer valve] operation.
   a. Style: [Close coupled] [One piece].
      1) Bowl Type: [Elongated] [Round front] with [siphon-jet] <Insert type> design. Include bolt caps matching fixture.
      2) Height: [Standard] [Accessible] [Juvenile] [Child].
      3) Design Consumption: [1 gal./flush (3.8 L/flush)] [1.6 gal./flush (6 L/flush)] [3.5 gal./flush (13.3 L/flush)] <Insert rate>.
      4) Tank: [Gravity type with trim] [Flushometer-tank type with trim and pressurized tank]. Include cover.
      5) Trip Mechanism: [Lever-handle] [Push-button] <Insert type> actuator.
      6) Color: [White] <Insert color>.
   b. Supply: [NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)] chrome-plated brass or copper with [wheel-handle] [screwdriver] [loose-key] <Insert type> stop.
   c. Style: Flushometer valve.
      1) Bowl Type: [Elongated] [Round front] with [siphon-jet] [reverse-trap] [blowout] [siphon-vortex] [siphon-wash] [washdown] design. Include bolt caps matching fixture.
      2) Height: [Standard] [Accessible] [Juvenile] [Child].
      3) Design Consumption: [1.6 gal./flush (6 L/flush)] [3.5 gal./flush (13.3 L/flush)] <Insert rate>.
      4) Color: [White] <Insert color>.
   d. Flushometer: <Insert designation.>
   e. Toilet Seat: <Insert designation.>

C. Water Closets, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Crane Plumbing, L.L.C./Fiat Products.
   b. Eljer.
   c. Kohler Co.
   d. <Insert manufacturer's name.>
   e. American Standard Companies, Inc.
   f. Briggs Plumbing Products, Inc.
   g. Eljer.
   h. Water Management, Inc.
   i. <Insert manufacturer's name.>
   j. American Standard Companies, Inc.
   k. Crane Plumbing, L.L.C./Fiat Products.
   l. Eljer.
   m. Kohler Co.
   n. <Insert manufacturer's name.>
4. Description [Accessible, floor] [Floor]-mounting, back-outlet, vitreous-china fixture designed for [gravity-tank] [flushometer-tank] [flushometer-valve] operation.
   a. Style: Close coupled.
      1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
      2) Height: [Standard] [Accessible].
      3) Design Consumption: [1.6 gal./flush (6 L/flush)] <Insert rate>.
      4) Tank: Gravity type with trim. Include cover.
      5) Trip Mechanism: [Lever-handle] <Insert type> actuator.
      6) Color: [White] <Insert color>.
   b. Supply: [NPS 1/2 (DN 15)] <Insert size> chrome-plated brass or copper with [wheel-handle] [screwdriver] [loose-key] <Insert type> stop.
   c. Style: Flushometer valve.
      1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
      2) Height: [Standard] [Accessible].
      3) Design Consumption: [1.6 gal./flush (6 L/flush)] [3.5 gal./flush (13.3 L/flush)].
      4) Color: [White] <Insert color>.
   d. Flushometer: <Insert designation.>
   e. Toilet Seat: <Insert designation.>
   f. Wall Support: Manufactured waste fitting with seal and fixture bolts.

2.17 URINALS

A. Urinals, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Briggs Plumbing Products, Inc.
   c. Capizzi.
   d. Crane Plumbing, L.L.C./Fiat Products.
   e. Duravit USA, Inc.
   f. Eljer.
   g. Kohler Co.
   h. Mansfield Plumbing Products, Inc.
   i. Peerless Pottery, Inc.
   j. Sanitarios Azteca, S.A. de C.V.
   k. St. Thomas Creations.
   l. TOTO USA, Inc.
   m. <Insert manufacturer's name.>
4. Description: [Accessible, wall] [Wall]-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
   a. Type: [Blowout] [Siphon jet] [Blowout with extended shields] [Siphon jet with extended shields] [Washout with extended shields].
   b. Strainer or Trapway: [Integral cast strainer] [Separate removable strainer] [Open trapway] with integral trap.
   c. Design Consumption: [0.5 gal./flush (1.9 L/flush)] [1 gal./flush (3.8 L/flush)] [1.5 gal./flush (5.7 L/flush)] <Insert rate>.
   d. Color: [White] <Insert color>.
   e. Supply Spud Size: [NPS 3/4 (DN 20)] [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)].
   f. Outlet Size: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] [NPS 3 (DN 80)].
   g. Flushometer: <Insert designation.>
   h. Fixture Support: Urinal <Insert designation> chair carrier.

B. Urinals, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Briggs Plumbing Products, Inc.
   c. Crane Plumbing, L.L.C./Fiat Products.
   d. Eljer.
   e. Kohler Co.
   f. Mansfield Plumbing Products, Inc.
   g. Peerless Pottery, Inc.
   h. St. Thomas Creations.
   i. TOTO USA, Inc.
   j. <Insert manufacturer's name.>
4. Description [Accessible, wall] [Wall]-mounting, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.
   a. Type: [Washout] [Washdown].

b. Strainer or Trapway: [Integral cast strainer] [Separate removable strainer] [Open trapway].
c. Design Consumption: [0.5 gal./flush (1.9 L/flush)] [1 gal./flush (3.8 L/flush)] <Insert rate>.
d. Color: [White] <Insert color>.
e. Supply Spud Size: NPS 3/4 (DN 20).
f. Outlet Size: NPS 1-1/2 (DN 40).
g. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
h. Flushing Device: Fixture manufacturer's standard matching fixture.
i. Flushometer: <Insert designation.>
j. Fixture Support: Urinal <Insert designation> chair carrier.

C. Urinals, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. American Standard Companies, Inc.
b. Crane Plumbing, L.L.C./Fiat Products.
c. Eljer.
d. Kohler Co.
e. <Insert manufacturer's name.>
4. Description Stall-type, bottom-outlet, vitreous-china fixture designed for flushometer valve operation.
a. Type: [Straight front] [Sloped front], with seam cover for [21-inch (535-mm)] [24-inch (610-mm)] centers.
b. Strainer or Trapway: Separate removable strainer.
c. Design Consumption: 1 gal./flush (3.8 L/flush).
d. Color: [White] <Insert color>.
e. Supply Spud Size: NPS 3/4 (DN 20).
f. Outlet Size: NPS 2 (DN 50).
g. Flushometer: <Insert designation.>

D. Urinals, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Commercial Enameling Company.
b. Eljer.
c. Kohler Co.
d. <Insert manufacturer's name.>

4. Description: Wall-mounting, bottom-outlet, trough-type, enameled, cast-iron fixture modified for flushometer valve operation.
   a. Style: Similar to wash sink with back and without pedestal.
   b. Size: [36 inches (915 mm)] [48 inches (1219 mm)] [60 inches (1525 mm)] [72 inches (1830 mm)].
   c. Color: [White] <Insert color>.
   d. Drain: Separate removable dome strainer.
   e. Design Consumption: [Not applicable] <Insert rate>.
   f. Supply: NPS 1/2 (DN 15).
   g. Outlet Size: NPS 1-1/2 (DN 40).
   h. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
   i. Flushing Device: Fixture manufacturer's standard, with washdown pipe, matching fixture.
   j. Fixture Support: Sink <Insert designation> chair carrier.

E. Urinals, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Falcon Waterfree Technologies.
   b. Waterless Co.
   c. <Insert manufacturer's name.>
   d. Duravit USA, Inc.
   e. Falcon Waterfree Technologies.
   f. <Insert manufacturer's name.>
4. Description [Accessible, wall] [Wall]-mounting, back-outlet dry, [plastic] [vitreous-china] fixture designed for liquid-trap-seal operation.
   a. Type: Without water supply.
   b. Trap-Seal Method: Proprietary cartridge or trap system.
   c. Color: [White] <Insert color>.
   d. Outlet Size: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)]. Include transition coupling, if required.
   e. Trap-Sealing Liquid: Proprietary.
   f. Fixture Support: Urinal <Insert designation> chair carrier.

2.18 BIDETS

A. Bidets, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Duravit USA, Inc.
e. Eljer.
f. Gerber Plumbing Fixtures LLC.
g. Kohler Co.
h. Mansfield Plumbing Products, Inc.
i. St. Thomas Creations.
j. <Insert manufacturer's name.>

4. Description: Floor-mounting, vitreous-china fixture with fittings.
   a. Type: With [spray] [flushing rim] [spray and flushing rim] and overflow. Include bolt caps matching fixture.
   b. Faucet Hole Punching: [One] [Two] [Three] [Four] [No] hole(s).
   c. Color: [White] <Insert color>.
   d. Faucet: Fixture manufacturer's standard, or two-valve supply, provided by fixture supplier, with [vacuum breaker, diverter, submerged spray,] [over-rim filling,] pop-up waste, and chrome-plated finish.
   e. Supplies: [NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)] chrome-plated copper with stops.
   f. Drain Piping: NPS 1-1/4 (DN 32) chrome-plated, cast-brass P-trap; [0.032-inch- (0.8-mm-)] [0.045-inch- (1.1-mm-)] thick tubular brass waste to wall; and wall escutcheon.

2.19 LAVATORIES

A. Lavatories, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. American Standard Companies, Inc.
      b. Commercial Enameling Company.
      c. Eljer.
      d. Kohler Co.
      e. <Insert manufacturer's name.>
      f. American Standard Companies, Inc.
      g. Barclay Products, Ltd.
      h. Briggs Plumbing Products, Inc.
      i. Crane Plumbing, L.L.C./Fiat Products.
      j. Eljer.
      k. Gerber Plumbing Fixtures LLC.
      l. Kohler Co.
      m. Mansfield Plumbing Products, Inc.
      n. Peerless Pottery, Inc.
      o. Sterling Plumbing Group, Inc.
      p. St. Thomas Creations.
      q. TOTO USA, Inc.

r. <Insert manufacturer's name.>

4. Description: [Accessible, wall] [Wall] [Wall-and-pedestal]-mounting, [enameled, cast-iron] [vitreous-china] fixture.
   a. Type: [With back] [Ledge back] [Shelf back] [Slab] [Pedestal].
   b. Size: [18 by 15 inches (457 by 381 mm)] [19 by 16 inches (483 by 406 mm)] [20 by 18 inches (508 by 457 mm)] [24 by 20 inches (610 by 508 mm)] <Insert dimensions> rectangular.
   c. Faucet Hole Punching: [One hole] [Three holes, 2-inch (51-mm) centers] [Three holes, 4-inch (102-mm) centers].
   d. Faucet Hole Location: [Top] [Front wall] [Inclined panel].
   e. Pedestal: [Not required] [Required].
   f. Color: [White] <Insert color>.
   g. Faucet: Lavatory <Insert designation> [with pop-up waste] [for separate drain].
   h. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
   i. Drain: [See faucet] [Grid] [Grid with offset waste] <Insert drain>.
      1) Location: [Not applicable] [Near back of bowl] <Insert location>.
   j. Drain Piping: [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] chrome-plated, cast-brass P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], [0.032-inch- (0.8-mm-)] [0.045-inch- (1.1-mm-)] thick tubular brass waste to wall; and wall escutcheon.
   k. Drain Piping: Schedule 40 [ABS] [or] [PVC], [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], tubular waste to wall; and wall escutcheon.
      1) Exception: Omit P-trap if hair interceptor is required.
   l. Hair Interceptor: [Not required] <Insert designation.>
   m. Protective Shielding Guard(s): <Insert designation.>
   n. Fixture Support: Lavatory <Insert designation>.

B. Lavatories, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Commercial Enameling Company.
      b. Eljer.
      c. Kohler Co.
      d. <Insert manufacturer's name.>
      e. Sterling Plumbing Group, Inc.
      f. <Insert manufacturer's name.>
      g. Benjamin Manufacturing Co., Inc.
      h. Royal Baths Manufacturing Co.
      i. <Insert manufacturer's name.>
      j. American Standard Companies, Inc.
      k. Bootz Plumbingware Co.
      l. Briggs Plumbing Products, Inc.
      m. Crane Plumbing, L.L.C./Fiat Products.
      n. Eljer.

o. Mansfield Plumbing Products, Inc.
p. <Insert manufacturer's name.>
q. American Standard Companies, Inc.
r. Avonite, Inc.
s. Bradley Corporation.
t. DuPont, Corian Products.
u. Formica Corporation.
v. Franke Consumer Products, Inc., Kitchen Systems Div.
w. Lippert Corporation.
x. Rynone Manufacturing Corp.
y. Swan Corporation (The).
z. <Insert manufacturer's name.>
aa. Acorn Engineering Company.
bb. Elkay Manufacturing Co.
cc. Intersan Manufacturing Company.
dd. Just Manufacturing Company.
ee. <Insert manufacturer's name.>
ff. American Standard Companies, Inc.
gg. Barclay Products, Ltd.
hh. Briggs Plumbing Products, Inc.
ii. Crane Plumbing, L.L.C./Fiat Products.
jj. Eljer.
kk. Gerber Plumbing Fixtures LLC.
ll. Kohler Co.
mm. Mansfield Plumbing Products, Inc.
nn. Peerless Pottery, Inc.
oo. Sterling Plumbing Group, Inc.
pp. St. Thomas Creations.
qq. TOTO USA, Inc.
rr. <Insert manufacturer's name.>

4. Description: [Accessible] [Counter-mounting] [Undercounter-mounting], [enameled, cast-iron] [FRP] [PMMA] [porcelain-enameled, formed-steel] [solid-surface] [stainless-steel] [vitreous-china] fixture.
   a. Type: [Flat rim with ledge] [Self-rimming].
   b. Rectangular Lavatory Size: [18 by 15 inches (457 by 381 mm)] [19 by 16 inches (483 by 406 mm)] [20 by 18 inches (508 by 457 mm)] [24 by 20 inches (610 by 508 mm)] <Insert dimensions>.
   c. Oval Lavatory Size: [19 by 16 inches (483 by 406 mm)] [20 by 17 inches (508 by 432 mm)] <Insert dimensions>.
   d. Round Lavatory Size: [18 inches (457 mm)] [19 inches (483 mm)] <Insert dimensions> in diameter.
   e. Faucet Hole Punching: [One hole] [Three holes, 2-inch (51-mm) centers] [Three holes, 4-inch (102-mm) centers].
   f. Faucet Hole Location: [Top] [Front wall] [Inclined panel].
   g. Color: [White] <Insert color>.
   h. Faucet: Lavatory <Insert designation> [with pop-up waste] [for separate drain].
   i. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
   j. Drain: [See faucet] [Grid] [Grid with offset waste] <Insert drain>.
      1) Location: [Not applicable] [Near back of bowl] <Insert location>.
   k. Drain Piping: [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] chrome-plated, cast-brass P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-

1/2 (DN 40)], [0.032-inch- (0.8-mm-)] [0.045-inch- (1.1-mm-)] thick tubular brass waste to wall; and wall escutcheon.

l. Drain Piping: Schedule 40 [ABS] [or] [PVC], [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], tubular waste to wall; and wall escutcheon.
   1) Exception: Omit P-trap if hair interceptor is required.

m. Hair Interceptor: [Not required] <Insert designation>.

n. Protective Shielding Guard(s): <Insert designation.>

C. Lavatories, <Insert drawing designation>:

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

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

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Crane Plumbing, L.L.C./Fiat Products.
   b. RSI Home Products.
   c. Rynone Manufacturing Corp.
   d. <Insert manufacturer's name.>
   e. Avonite, Inc.
   f. DuPont, Corian Products.
   g. Formica Corporation.
   h. Lippert Corporation.
   i. Swan Corporation (The).
   j. Wilsonart International.
   k. <Insert manufacturer's name.>

4. Description: [Accessible]countertop with integral bowl fixtures for mounting on base unit.
   a. Backsplash: [Integral with countertop] [Separate, same material as countertop] [Not required].
   b. Overall Rectangular Top Size: [25 by 17 inches (635 by 432 mm)] [31 by 19 inches (787 by 483 mm)] [49 by 22 inches (1245 by 559 mm)] [73 by 22 inches (1854 by 559 mm)] <Insert dimensions> with [1] [2] [3] [4] bowl(s).
      1) Bowl Size: Oval [19 by 16 inches (483 by 406 mm)] [20 by 17 inches (508 by 432 mm)] <Insert dimensions>.
   c. Faucet Hole Punching: [One hole] [Three holes, 2-inch (51-mm) centers] [Three holes, 4-inch (102-mm) centers].
   d. Faucet Hole Location: [Countertop] <Insert location>.
   e. Color: [White] <Insert color>.
   f. Faucet(s): Lavatory <Insert designation> [with pop-up waste] [with separate drain] for each bowl.
   g. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
   h. Drain(s): [See faucets] [Grid] [Grid with offset waste] <Insert drain>.
      1) Location: [Not applicable] [Near back of bowl] <Insert location>.
   i. Drain Piping: [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] chrome-plated, cast-brass P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], [0.032-inch- (0.8-mm-)] [0.045-inch- (1.1-mm-)] thick tubular brass waste to wall; and wall escutcheon.

j. Drain Piping: Schedule 40 [ABS] [or] [PVC], [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], tubular waste to wall; and wall escutcheon.
k. Hair Interceptor(s): <Insert designation> for bowls as indicated.
l. Protective Shielding Guard(s): <Insert designation> for bowls as indicated.

D. Lavatories, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Eljer.
e. Kohler Co.
f. Mansfield Plumbing Products, Inc.
g. Peerless Pottery, Inc.
h. St. Thomas Creations.
i. <Insert manufacturer's name.>
4. Description: Accessible, wall-mounting, vitreous-china fixture designed for people in wheelchairs.
a. Type: [Ledge back] [Shelf back] [Slab] <Insert type>.
b. Size: [20 by 26 inches (508 by 660 mm)] <Insert dimensions> minimum; rectangular.
c. Faucet Hole Punching: [One hole] [Three holes, 2-inch (51-mm) centers] [Three holes, 4-inch (102-mm) centers] [Three holes, 8-inch (203-mm) centers] [Three holes, 12-inch (305-mm) centers].
d. Color: [White] <Insert color>.
e. Faucet: Lavatory <Insert designation> for separate drain.
f. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
g. Drain: [Grid] [Grid with offset waste].
h. Drain Piping: [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] chrome-plated, cast-brass P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
i. Drain Piping: Schedule 40 [ABS] [or] [PVC], [NPS 1-1/4 (DN 32)] [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] P-trap; [NPS 1-1/4 (DN 32)] [NPS 1-1/2 (DN 40)], tubular waste to wall; and wall escutcheon.
j. Fixture Support: Lavatory <Insert designation>.

2.20 COMMERCIAL SINKS

A. Commercial Sinks, <Insert drawing designation>:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Advance Tabco.
   b. Elkay Manufacturing Co.
   c. Just Manufacturing Company.
   d. Metal Masters Foodservice Equipment Co., Inc.
   e. <Insert manufacturer's name.>
4. Description: [One] [Two] [Three]-compartment, counter-mounting, stainless-steel commercial sink with backsplash.
   a. Overall Dimensions: <Insert dimensions.>
   b. Metal Thickness: [0.050 inch (1.3 mm)] <Insert dimension>.
   c. Compartment:
      1) Dimensions: <Insert dimensions.>
      2) Drain: [Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain] [Grid with NPS 2 (DN 50) tailpiece and twist drain] [NPS 1-1/2 (DN 40) tailpiece with stopper] [NPS 1-1/2 (DN 40) tailpiece with pop-up waste] <Insert drain>.
         a) Location: [Centered in compartment] [Near back of compartment] [Near left side of compartment] [Near right side of compartment] <Insert location>.
   d. Each Compartment:
      1) Dimensions: <Insert dimensions.>
      2) Drains: [Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain] [Grid with NPS 2 (DN 50) tailpiece and twist drain] [NPS 1-1/2 (DN 40) tailpiece with stopper] [NPS 1-1/2 (DN 40) tailpiece with pop-up waste] <Insert drain>.
         a) Location: [Centered in compartment] [Near back of compartment] <Insert location>.
   e. Faucet(s): Sink <Insert designation>.
      1) Number Required: [One] [Two].
      2) Mounting: Deck.
   f. Supplies: [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)] chrome-plated copper with stops or shutoff valves.
   g. Drain Piping: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] chrome-plated, cast-brass P-trap; [0.045-inch- (1.1-mm-) thick tubular brass] [copper pipe] waste to wall; [continuous waste;]and wall escutcheon(s).

B. Commercial Sinks, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Advance Tabco.

b. AERO Manufacturing, Inc.
c. Amtekco Industries, Inc.
d. Elkay Manufacturing Co.
e. Just Manufacturing Company.
f. Marlo Manufacturing.
g. Metal Masters Foodservice Equipment Co., Inc.
h. <Insert manufacturer's name.>

4. Description: [One] [Two] [Three]-compartment, freestanding, stainless-steel commercial sink with backsplash.
   a. Overall Dimensions: <Insert dimensions.>
   b. Metal Thickness: [0.050 inch (1.3 mm)] [0.063 inch (1.6 mm)] <Insert dimension>.
   c. Compartment:
      1) Dimensions: <Insert dimensions.>
      2) Drain: [Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain] [Grid with NPS 2 (DN 50) tailpiece and twist drain] [NPS 1-1/2 (DN 40) tailpiece with stopper] [NPS 1-1/2 (DN 40) tailpiece with pop-up waste] <Insert drain>.
         a) Location: [Centered in compartment] [Near back of compartment] [Near left side of compartment] [Near right side of compartment] <Insert location>.
   d. Each Compartment:
      1) Dimensions: <Insert dimensions.>
      2) Drains: [Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain] [Grid with NPS 2 (DN 50) tailpiece and twist drain] [NPS 1-1/2 (DN 40) tailpiece with stopper] [NPS 1-1/2 (DN 40) tailpiece with pop-up waste] <Insert drain>.
         a) Location: [Centered in compartment] [Near back of compartment] <Insert location>.
   e. Drainboard(s): [Not required] [Both] [Left] [Right] side(s).
      1) Dimensions Each: [Not applicable] <Insert dimensions>.
   f. Supports: Adjustable-length, steel legs.
   g. Faucet(s): Sink <Insert designation>.
      1) Number Required: [One] [Two].
      2) Mounting: In backsplash.
   h. Supplies: [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)] chrome-plated copper with stops or shutoff valves.
   i. Drain Piping: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] chrome-plated, cast-brass P-trap; [0.045-inch- (1.1-mm-) thick tubular brass] [copper pipe] waste to wall; [continuous waste;]and wall escutcheon(s).

C. Commercial Sinks, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Advance Tabco.
   b. AERO Manufacturing, Inc.
   c. Amtekco Industries, Inc.

d. Elkay Manufacturing Co.
e. Just Manufacturing Company.
f. Marlo Manufacturing.
g. Metal Masters Foodservice Equipment Co., Inc.
h. <Insert manufacturer's name.>

4. Description: Wall-mounting, stainless-steel, commercial, handwash-sink fixture.
   a. Type: Basin with radius corners, back for faucet, and support brackets.
   b. Size; Approximately 17 by 16 by 5 inches (432 by 406 by 127 mm).
   c. Faucet: Back-mounting, chrome-plated, solid-brass, gooseneck type with individual valves.
   d. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.
   e. Drain: Grid.
   f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
   g. Fixture Support: Sink <Insert designation> for wall-mounting installation.

2.21 SHAMPOO BOWLS

A. Shampoo Bowls, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Belvedere USA Corporation; a Subsidiary of the Wella Corporation, North America.
   b. <Insert manufacturer's name.>
   c. Belvedere USA Corporation; a Subsidiary of the Wella Corporation, North America.
   d. Marble Products USA; a division of Takara Belmont.
   e. <Insert manufacturer's name.>
4. Description [Enameled, cast-iron] [PMMA] fixture shaped for head rest. Include vacuum breaker, faucet, hose and spray, drain, and mounting brackets.
   a. Color: [White] <Insert color>.
   b. Supplies: [NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)] chrome-plated copper with stops.
   c. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
   d. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap; tubular waste to wall; and wall escutcheon.
   e. Hair Interceptor: <Insert designation.>
   f. Fixture Support for Counter Mounting: Brackets or forms.
   g. Fixture Support for Wall Mounting: Sink <Insert designation>.

2.22 WASH FOUNTAINS

A. Wash Fountains, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Acorn Engineering Company.
      b. Bradley Corporation.
      c. Intersan Manufacturing Company.
      d. <Insert manufacturer's name.>
   4. Description: [Accessible,] [Circular,] freestanding-design, wash-up fixture.
      a. Arrangement: Wash-up stations facing central spray head.
      b. Receptor Material: [Precast terrazzo] [Stainless steel] [Solid surface] on base.
      c. Receptor Color or Finish: [Not applicable] <Insert if required>.
      d. Size: [36- to 39-inch (914- to 990-mm)] [54-inch (1370-mm)] diameter.
      e. Number of Stations: [Two] [Three] [Four] [Five] [Six] [Eight].
      f. Control: [Collective] [Individual], [push-button] [foot-pedal] [sensor] actuation with thermostatic valve and check stops or field-installed check valves.
      g. Liquid Soap Dispensers: [Manual] [Sensor], for each station.
      h. Mounting: Floor.
      i. Supplies: [NPS 3/4 (DN 20)] [NPS 1 (DN 25)] copper tubing with ball, gate, or globe valves from [bottom] [top].
      j. Shroud: [Not required] [Stainless steel of size to cover supplies and vent piping].
      k. Drain: Grid with NPS 2 (DN 50) tailpiece.
      l. Trap Fitting: [Not required] [NPS 2 (DN 50) trap with waste and vent connections].
      m. Drain Piping: [NPS 1-1/2 (DN 40),] [NPS 2 (DN 50),] waste to floor.
      n. Vent Piping: [Not required] [NPS 1-1/2 (DN 40) to ceiling].

B. Wash Fountains, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Acorn Engineering Company.
      b. Bradley Corporation.
      c. Intersan Manufacturing Company.
      d. <Insert manufacturer's name.>
   4. Description: [Accessible] [Semicircular] [Corner] design, wash-up fixture.
      a. Arrangement: Wash-up stations facing central spray head.

b. Receptor Material: [Precast terrazzo] [Stainless steel] [Solid surface] on base.
c. Receptor Color or Finish: [Not applicable] <Insert if required>.
d. Size: [36- to 39-inch (914- to 990-mm)] [54-inch (1370-mm)] diameter.
e. Number of Stations: [Two] [Three] [Four].
f. Control: [Collective] [Individual], [push-button] [foot-pedal] [sensor] actuation with thermostatic valve and check stops or field-installed check valves.
g. Liquid Soap Dispensers: [Manual] [Sensor], for each station.
h. Mounting: Floor and flush-to-wall with wall bracket.
i. Supplies: [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)] copper tubing with ball, gate, or globe valves.
j. Drain: Grid with [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] tailpiece.
k. Drain Piping: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] P-trap, waste to wall, and wall flange.

C. Wash Fountains, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Acorn Engineering Company.
b. Bradley Corporation.
c. Intersan Manufacturing Company.
d. <Insert manufacturer's name.>
4. Description: [Accessible,] [Flush-to-wall,] linear design, wash-up fixture.
a. Arrangement: Wash-up stations facing spray heads.
b. Receptor Material: [Precast terrazzo] [Stainless steel] [Solid surface] on base.
c. Receptor Color or Finish: [Not applicable] <Insert if required>.
d. Number of Stations: [One] [Two] [Three] [Four].
e. Control: [Collective] [Individual], [push-button] [sensor] actuation with thermostatic valve and check stops or field-installed check valves.
f. Liquid Soap Dispensers: [Manual] [Sensor], for each station.
g. Mounting: Floor mounting with bracket for attaching to wall.
h. Faucet(s): [Push-button] [Sensor-actuated] mixing valve with check stops.
i. Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.
j. Drain: Grid with NPS 1-1/2 (DN 40) tailpiece.
k. Drain Piping: NPS 1-1/2 (DN 40) P-trap, waste to wall, and wall flange.

2.23 BATHTUBS

A. Bathtubs, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
    a. Eljer.
    b. Jacuzzi, Inc.
    c. Kohler Co.
    d. <Insert manufacturer's name.>
    e. American Standard Companies, Inc.
    f. Bootz Plumbingware Co.
    g. Briggs Plumbing Products, Inc.
    h. Crane Plumbing, L.L.C./Fiat Products.
    i. Mansfield Plumbing Products, Inc.
    j. <Insert manufacturer's name.>
    k. Aker Plastics Co., Inc.
    l. Best Bath Systems; a div. of Fiberglass Systems, Inc.
    m. Clarion Bathware.
    n. Florestone Products Co., Inc.
    o. Praxis Industries, Inc.; Aquarius Products.
    p. Sterling Plumbing Group, Inc.
    q. Swan Corporation (The).
    r. <Insert manufacturer's name.>
    s. Acryline USA, Inc.
    t. American Standard Companies, Inc.
    u. Aqua Bath Company, Inc.
    v. Aqua Glass Corporation.
    w. Aquatic Industries, Inc.
    x. Best Bath Systems; a div. of Fiberglass Systems, Inc.
    y. Clarion Bathware.
    z. Crane Plumbing, L.L.C./Fiat Products.
    aa. Florestone Products Co., Inc.
    bb. Kohler Co.
    cc. Lyons Industries, Inc.
    dd. Mansfield Plumbing Products, Inc.; Acrylic Operations.
    ee. Praxis Industries, Inc.; Aquarius Products.
    ff. St. Thomas Creations.
    gg. Swan Corporation (The).
    hh. <Insert manufacturer's name.>
4. Description: [Enameled, cast-iron] [FRP] [PMMA] [Porcelain-enameled, formed-steel] fixture.
    a. Bathing Surface: Slip resistant.
    b. Size: [48 by 30 inches (1220 by 765 mm)] [60 by 30 inches (1525 by 765 mm)] [66 by 30 inches (1680 by 765 mm)] <Insert dimensions> [with front apron] [drop-in type].
    c. Color: [White] <Insert color>.
    d. Drain Location: [Left] [Right] end.
    e. Accessibility Options: Include grab bar and bench.
    f. Faucet: [Bathtub] [Bathtub/shower] <Insert designation>.
    g. Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.

h. Drain: NPS 1-1/2 (DN 40); chrome-plated exposed parts; brass pop-up waste and overflow.
i. Drain Piping: NPS 1-1/2 (DN 40) cast-brass P-trap and waste.
j. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap and waste.

2.24 INDIVIDUAL SHOWERS

A. Individual Showers, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Aker Plastics Co., Inc.
b. Aqua Glass Corporation.
c. Clarion Bathware.
d. Florestone Products Co., Inc.
e. LASCO Bathware.
f. Praxis Industries, Inc.; Aquarius Products.
g. Sterling Plumbing Group, Inc.
h. Swan Corporation (The).
i. <Insert manufacturer's name.>
j. Acryline USA, Inc.
k. Aker Plastics Co., Inc.
l. Aqua Bath Company, Inc.
m. Aqua Glass Corporation.
n. Aquatic Industries, Inc.
o. Clarion Bathware.
p. Crane Plumbing, L.L.C./Fiat Products.
q. Jacuzzi, Inc.
r. Kohler Co.
s. LASCO Bathware.
t. Praxis Industries, Inc.; Aquarius Products.
u. <Insert manufacturer's name.>
4. Description: [Accessible,] [FRP] [PMMA] shower enclosure with slip-resistant bathing surface and shower rod with curtain.
a. Size: [36 by 34 inches (915 by 865 mm)] [42 by 36 inches (1065 by 915 mm)] [43 by 39 inches (1090 by 990 mm)] [48 by 34 inches (1220 by 865 mm)] [52 by 36 inches (1320 by 915 mm)] [60 by 36 inches (1525 by 915 mm)] [72 by 36 inches (1830 by 915 mm)] <Insert dimensions>.
b. Surround: One piece[or sealed, multiple piece].
c. Surround: One piece.
d. Color: [White] <Insert color>.
e. Drain Location: [Left side] [Center] [Right side].
f. Accessibility Options: Include grab bar and bench.
g. Faucet: Shower <Insert designation>.
h. Drain: Grid, NPS 2 (DN 50).

B. Individual Showers, <Insert drawing designation>:
   1. Description: Components for built-up shower.
      a. Shower Faucet: <Insert designation>.
      b. Receptor: [Not required] <Insert shower receptor designation>.

C. Individual Showers, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Crane Plumbing, L.L.C./Fiat Products.
      b. Mustee, E. L. & Sons, Inc.
      c. Stern-Williams Co., Inc.
      d. Swan Corporation (The).
      e. <Insert manufacturer's name.>
   4. Description: Factory-fabricated, [accessible,]cabinet type with faucet and receptor.
      a. Size: [30 by 30 inches (760 by 760 mm)] [32 by 32 inches (815 by 815 mm)] [36 by 36 inches (915 by 915 mm)] [36 by 39 inches (915 by 990 mm)] [45 by 39 inches (1145 by 990 mm)] <Insert dimensions>.
      b. Material: [Steel] [Composite] [Plastic], [front] [corner] [front and rear] access.
      c. Color: [Not applicable] <Insert color>.
      d. Accessibility Options: Grab bar and bench.
      e. Faucet: Shower <Insert designation>.
      f. Supplies: NPS 1/2 (DN 15) copper tubing[with ball, gate, or globe valves].
      g. Drain: Grid, NPS 2 (DN 50).

2.25 GROUP SHOWERS

A. Group Showers, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Acorn Engineering Company.
      b. Bradley Corporation.
      c. <Insert manufacturer's name.>
   4. Description: Stainless-steel column fixture with [two] [three] [four] [five] [six] individual showers.
      a. Height to Shower Heads: [66 inches (1675 mm)] [72 inches (1830 mm)] <Insert dimension>.

b. Control: [Thermostatic] [Pressure-balance] valve with individual hot- and cold-water mixing valve operation.
c. Control: Thermostatic valve with individual tempered-water supply and [push-button] [sensor] operation.
d. Flow Control: [2 gpm (7.6 L/min.)] [2.5 gpm (9.5 L/min.)] for each shower head.
e. Liquid Soap Dispenser: For each shower.
f. Mounting: Floor flange.
g. Supplies: [NPS 3/4 (DN 20)] [NPS 1 (DN 25)] copper tubing with ball, gate, or globe valves from [bottom] [top].
h. Shroud: [Not required] [Stainless steel of size to cover supplies and vent piping].
i. Drain Fitting: [NPS 3 (DN 80)] [NPS 4 (DN 100)] outlet with NPS 2 (DN 50) vent, integral with base of column.
j. Vent Piping: [Not required] [NPS 2 (DN 50) to ceiling].

B. Group Showers, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Acorn Engineering Company.
b. Bradley Corporation.
c. <Insert manufacturer's name.>
4. Description: Wall-mounting fixture with stainless-steel surface enclosure with [two] [three] individual showers.
a. Control: [Thermostatic] [Pressure-balance] valve with individual hot- and cold-water mixing valve operation.
b. Control: Thermostatic valve with individual tempered-water supply and [push-button] [sensor] operation.
c. Flow Control: [2 gpm (7.6 L/min.)] [2.5 gpm (9.5 L/min.)] for each shower head.
d. Liquid Soap Dispenser: For each shower.
e. Mounting: Wall bracket.
f. Supplies: NPS 3/4 (DN 20) copper tubing with ball, gate, or globe valves.

C. Group Showers, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. ShowerTower Inc.
b. <Insert manufacturer's name.>
4. Description: Freestanding, plastic group-shower fixture.

a. Number of Shower Stations: [One] [Two] [Three] [Four] <Insert number up to six> with individual self-closing control valve(s).
b. Number of Foot Wash Stations: [One] [Two] <Insert number> with individual self-closing control valve(s).
c. Hose Bibb: [Not] [One] required.
d. Control-Valve Mounting Height: [50 inches (1270 mm)] [48 inches (1219 mm)].
e. Material: Cast-filled-polymer plastic.
f. Color: [Gray] <Insert color>.
g. Internal Piping: Factory installed.
h. Mounting: Base flange with bolt holes.

D. Group Showers, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Most Dependable Fountains, Inc.
b. Stern-Williams Co., Inc.
c. <Insert manufacturer's name.>
4. Description: Freestanding, steel group-shower fixture.
a. Number of Shower Stations: [One] [Two] with individual self-closing control valve(s).
b. Number of Foot Wash Stations: [One] [Two] with individual self-closing control valve(s).
c. Material: Painted steel pipe.
d. Color: [Blue] <Insert color>.
e. Internal Piping: Factory installed.
f. Mounting: Base flange with bolt holes.

2.26 WHIRLPOOL BATHTUBS

A. Whirlpool Bathtubs, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Eljer.
b. Kohler Co.
c. <Insert manufacturer's name.>
d. Aker Plastics Co., Inc.
e. Best Bath Systems; a div. of Fiberglass Systems, Inc.
f. Clarion Bathware.
g. Praxis Industries, Inc.; Aquarius Products.
h. Sterling Plumbing Group, Inc.

i. <Insert manufacturer's name.>
j. Aker Plastics Co., Inc.
k. American Standard Companies, Inc.
l. American Whirlpool Products Corp.
m. Aqua Glass Corporation.
n. Aquatic Industries, Inc.
o. Benjamin Manufacturing Co., Inc.
p. Clarion Bathware.
q. Clarke Products, Inc.
r. Crane Plumbing, L.L.C./Fiat Products.
s. Eljer.
t. Florestone Products Co., Inc.
u. Jacuzzi, Inc.
v. Jason International, Inc.
w. Kohler Co.
x. LASCO Bathware.
y. Lyons Industries, Inc.
z. Mansfield Plumbing Products, Inc.; Acrylic Operations.
aa. Praxis Industries, Inc.; Aquarius Products.
bb. Royal Baths Manufacturing Co.
cc. Southland Spa & Sauna Inc.
dd. <Insert manufacturer's name.>
ee. American Standard Companies, Inc.
ff. Mansfield Plumbing Products, Inc.
gg. <Insert manufacturer's name.>

4. Description: Packaged, [enameled, cast-iron] [FRP] [PMMA] [porcelain-enameled, formed-steel] hydromassage bathtub with air-entrained-water jet nozzles and water circulation.
   a. Seating Capacity: [One] [Two] <Insert number> person(s).
   b. Bathing Surface: Slip resistant.
   c. Size: [60 by 30 inches (1525 by 765 mm)] [66 by 30 inches (1680 by 765 mm)] [60 by 42 inches (1525 by 1065 mm)] <Insert dimensions>.
   d. Nominal Water Capacity: <Insert gal. (L).>
   e. Base for Drop-in Unit: <Insert description> with access panel.
   f. Apron: Matching unit, covering exposed front and sides, and with access panel.
   g. Color: [White] <Insert color>.
   h. Drain Location: [Left] [Right] end.
   i. Controls: For pump[, timer,] [and water heater].
   j. Faucet: Fixture manufacturer's [individual valves] [mixing valve] with over-rim tub filler.
   k. Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.
   l. Drain: NPS 1-1/2 (DN 40); chrome-plated exposed parts; brass pop-up waste and overflow.
   m. Drain Piping: NPS 1-1/2 (DN 40) cast-brass P-trap and waste.
   n. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap and waste.
   o. Water-Circulating System: Electric circulating pump and plastic piping.
   p. Water Heater: Electric, inline.
   q. Unit Electrical Characteristics:
      1) Volts: [120] [240] [277] [480] <Insert number> V.

2) Phase(s): [One] [Three].
3) Hertz: [60] <Insert number> Hz.
4) Full-Load Amperes: <Insert value> A.
5) Minimum Circuit Ampacity: <Insert value> A.
6) Maximum Overcurrent Protection: <Insert value> A.

B. Whirlpool Bathtubs, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Acryline USA, Inc.
b. American Standard Companies, Inc.
c. American Whirlpool Products Corp.
d. Aqua Glass Corporation.
e. Aquatic Industries, Inc.
f. Jacuzzi, Inc.
g. Jason International, Inc.
h. Ultra Baths, Inc.
i. <Insert manufacturer's name.>
4. Description: Packaged, PMMA airmassage bathtub with air-injection nozzles.
a. Seating Capacity: [One] [Two] <Insert number> person(s).
b. Bathing Surface: Slip resistant.
c. Size: [60 by 30 inches (1525 by 765 mm)] [66 by 30 inches (1680 by 765 mm)] [60 by 42 inches (1525 by 1065 mm)] <Insert dimensions>.
d. Nominal Water Capacity: <Insert gal. (L).>
e. Base for Drop-in Unit: <Insert description> with access panel.
f. Apron: Matching unit, covering exposed front and sides, and with access panel.
g. Color: [White] <Insert color>.
h. Drain Location: [Left] [Right] end.
i. Controls: For blower[, timer,] [and water heater].
j. Faucet: Fixture manufacturer's [individual valves] [mixing valve] with over-rim tub filler.
k. Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.
l. Drain: NPS 1-1/2 (DN 40); chrome-plated exposed parts; brass pop-up waste and overflow.
m. Drain Piping: NPS 1-1/2 (DN 40) cast-brass P-trap and waste.
n. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap and waste.
o. Air-Injection System: Electric, [blower] [combination blower/heater] and plastic piping.
p. Unit Electrical Characteristics:
1) Volts: [120] [240] [277] [480] <Insert value> V.
2) Phase(s): [One] [Three].
3) Hertz: [60] <Insert value> Hz.
4) Full-Load Amperes: <Insert value> A.
5) Minimum Circuit Ampacity: <Insert value> A.

6) Maximum Overcurrent Protection: <Insert value> A.

2.27 KITCHEN SINKS

A. Kitchen Sinks, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
a. Commercial Enameling Company.
b. Eljer.
c. Jacuzzi, Inc.
d. Kohler Co.
e. <Insert manufacturer's name.>
f. Gerber Plumbing Fixtures LLC.
g. Lyons Industries, Inc.
h. <Insert manufacturer's name.>
i. American Standard Companies, Inc.
j. Bootz Plumbingware Co.
k. Briggs Plumbing Products, Inc.
l. Eljer.
m. Mansfield Plumbing Products, Inc.
n. <Insert manufacturer's name.>
o. Avonite, Inc.
p. DuPont, Corian Products.
q. FHP Kindred USA.
r. Formica Corporation.
s. Franke Consumer Products, Inc., Kitchen Systems Div.
t. Lippert Corporation.
u. Rynone Manufacturing Corp.
v. Swan Corporation (The).
w. Wilsonart International.
x. <Insert manufacturer's name.>
y. Dayton Products, Inc.
z. Elkay Manufacturing Co.
aa. Franke Consumer Products, Inc., Kitchen Systems Div.
bb. Just Manufacturing Company.
cc. Kohler Co.
dd. Moen, Inc.
ee. Revere Sink.
ff. Sterling Plumbing Group, Inc.
gg. Teka USA.
hh. WhiteRock Corp.
ii. <Insert manufacturer's name.>
4. Description: [One] [Two] [Three]-bowl, residential, counter-mounting, [enameled, cast-iron] [PMMA] [porcelain-enameled, formed-steel] [solid-surface] [stainless-steel] kitchen sink.
a. Overall Dimensions: <Insert dimensions.>

b. Metal Thickness: [0.038 inch (1.0 mm)] [0.050 inch (1.3 mm)] <Insert dimension>.
c. Bowl:
   1) Dimensions: <Insert dimensions.>
   2) Drain: 3-1/2-inch (89-mm) [crumb cup] [grid] [grid with offset waste] [outlet for disposer].
      a) Location: [Centered in bowl] [Near back of bowl] <Insert location>.
d. Left Bowl:
   1) Dimensions: <Insert dimensions.>
   2) Drain: 3-1/2-inch (89-mm) [crumb cup] [grid] [grid with offset waste] [outlet for disposer].
      a) Location: [Centered in bowl] [Near back of bowl] <Insert location>.
e. Right Bowl:
   1) Dimensions: <Insert dimensions.>
   2) Drain: 3-1/2-inch (89-mm) [crumb cup] [grid] [grid with offset waste] [outlet for disposer].
      a) Location: [Centered in bowl] [Near back of bowl] <Insert location>.
f. Center Bowl:
   1) Dimensions: <Insert dimensions.>
   2) Drain: [1-1/2-inch (38-mm)] [3-1/2-inch (89-mm)] [crumb cup] [grid] [grid with offset waste].
      a) Location: [Centered in bowl] <Insert location>.
g. Sink Faucet: <Insert designation.>
h. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.
i. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; [continuous waste;]and wall escutcheon(s).
j. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap; tubular waste to wall; [continuous waste;]and wall escutcheon(s).
k. Disposer: [Not required] <Insert designation>.
l. Dishwasher Air-Gap Fitting: [Required] [Not required].
m. Hot-Water Dispenser: [Not required] <Insert designation.>

B. Bar Sinks, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Commercial Enameling Company.
   b. Eljer.
   c. Jacuzzi, Inc.
   d. Kohler Co.
   e. <Insert manufacturer's name.>
   f. Benjamin Manufacturing Co., Inc.
   g. Gerber Plumbing Fixtures LLC.
   h. Lippert Corporation.

i. Lyons Industries, Inc.
j. Royal Baths Manufacturing Co.
k. <Insert manufacturer's name.>
l. American Standard Companies, Inc.
m. Bootz Plumbingware Co.
n. Briggs Plumbing Products, Inc.
o. Eljer.
p. Mansfield Plumbing Products, Inc.
q. <Insert manufacturer's name.>
r. Avonite, Inc.
s. DuPont, Corian Products.
t. Formica Corporation.
u. Swan Corporation (The).
v. <Insert manufacturer's name.>
w. Barclay Products, Ltd.
x. Dayton Products, Inc.
y. Elkay Manufacturing Co.
z. Franke Consumer Products, Inc.; Kitchen Systems Div.
aa. Just Manufacturing Company.
bb. Kohler Co.
cc. Moen, Inc.
dd. Revere Sink.
ee. Sterling Plumbing Group, Inc.
ff. WhiteRock Corp.
gg. <Insert manufacturer's name.>

4. Description: Single-bowl, residential, counter-mounting, [enameled, cast-iron] [PMMA] [stainless-steel] [porcelain-enameled, cast-iron] [solid-surface] bar sink.
   a. Overall Dimensions: <Insert dimensions.>
   b. Bowl Dimensions: <Insert dimensions.>
   c. Sink Faucet: <Insert designation.>
   d. Supplies: [NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)] chrome-plated copper with stops.
   e. Drain: [1-1/2-inch (38-mm)] [3-1/2-inch (89-mm)] [crumb cup] [grid] [grid with offset waste].
   f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
   g. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap; tubular waste to wall; and wall escutcheon.
   h. Protective Shielding Guard(s): <Insert designation.>

2.28 SERVICE SINKS

A. Service Sinks, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Commercial Enameling Company.
   c. Eljer.
   d. Kohler Co.
   e. <Insert manufacturer's name.>
   f. Crane Plumbing, L.L.C./Fiat Products.
   g. Eljer.
   h. Kohler Co.
   i. <Insert manufacturer's name.>
4. Description: Trap-standard- and wall-mounting, [enameled, cast-iron fixture with roll-rim] [vitreous-china fixture] with [plain] [two faucet holes in] back and rim guard on front and sides.
   a. Size: [22 by 18 inches (560 by 460 mm)] [24 by 20 inches (610 by 510 mm)].
   b. Size: [19 by 16 inches (480 by 405 mm)] [22 by 20 inches (560 by 510 mm)].
   c. Color: White.
   d. Faucet: Sink <Insert designation>.
   e. Drain: Grid with [NPS 2 (DN 50)] [NPS 3 (DN 80)] outlet.
   f. Trap Standard: [NPS 2 (DN 50)] [NPS 3 (DN 80)] enameled, cast iron with cleanout and floor flange.
   g. Fixture Support: Sink <Insert designation>.

B. Service Sinks, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. American Standard Companies, Inc.
   b. Commercial Enameling Company.
   c. Eljer.
   d. Kohler Co.
   e. <Insert manufacturer's name.>
4. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.
   a. Size: 28 by 28 inches (710 by 710 mm).
   b. Color: White.
   c. Faucet: Sink <Insert designation>.
   d. Drain: Grid with [NPS 2 (DN 50)] [NPS 3 (DN 80)] outlet.

2.29 SERVICE BASINS

A. Service Basins, <Insert drawing designation>:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
   a. Acorn Engineering Company.
   b. Crane Plumbing, L.L.C./Fiat Products.
   c. Florestone Products Co., Inc.
   d. Precast Terrazzo Enterprises, Inc.
   e. Stern-Williams Co., Inc.
   f. <Insert manufacturer's name.>
   g. Crane Plumbing, L.L.C./Fiat Products.
   h. Florestone Products Co., Inc.
   i. Mustee, E. L. & Sons, Inc.
   j. Swan Corporation (The).
   k. Zurn Plumbing Products Group; Light Commercial Operation.
   l. <Insert manufacturer's name.>
4. Description: Flush-to-wall, floor-mounting, [precast terrazzo] [cast-polymer] fixture with rim guard.
   a. Shape: [Square] [Rectangular] [Five sided] [Radial front].
   b. Size: [24 by 24 inches (610 by 610 mm)] [28 by 28 inches (710 by 710 mm)] [24 by 36 inches (610 by 915 mm)] [32 by 32 inches (815 by 815 mm)] [36 by 36 inches (915 by 915 mm)] <Insert dimensions>.
   c. Height: [6 inches (150 mm)] [10 inches (255 mm)] [12 inches (305 mm)] [12 inches (305 mm) with dropped front] <Insert dimensions>.
   d. Tiling Flange: [Not required] [On one side] [On two sides] [On three sides].
   e. Rim Guard: On [front] [all] top surfaces.
   f. Color: [Not applicable] <Insert color>.
   g. Faucet: Sink <Insert designation>.
   h. Drain: Grid with [NPS 2 (DN 50)] [NPS 3 (DN 80)] outlet.

2.30 LAUNDRY TRAYS

A. Laundry Trays, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Commercial Enameling Company.
      b. Eljer.
      c. <Insert manufacturer's name.>
      d. Crane Plumbing, L.L.C./Fiat Products.
      e. Florestone Products Co., Inc.
      f. Gerber Plumbing Fixtures LLC.
      g. Mustee, E. L. & Sons, Inc.
      h. Swan Corporation (The).
      i. Zurn Plumbing Products Group; Light Commercial Operation.

j. <Insert manufacturer's name.>

4. Description: [Stand] [Counter]-mounting, [enameled, cast-iron] [plastic] laundry trays.
   a. Size: [24 by 21 inches (610 by 535 mm)] [25 by 22 inches (635 by 560 mm)] <Insert dimensions>.
   b. Color: [Not applicable] <Insert color>.
   c. Faucet: Sink <Insert designation> for [fixture-ledge] [wall] [counter] mounting.
   d. Supplies: NPS 1/2 (DN 15) [chrome-plated copper with stops] [copper tubing with ball, gate, or globe valves].
   e. Drain: Grid with NPS 1-1/2 (DN 40) outlet.
   f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon.
   g. Drain Piping: Schedule 40 [ABS] [or] [PVC], NPS 1-1/2 (DN 40) P-trap; tubular waste to wall; and wall escutcheon.
   h. Stand: [Not required] [Painted steel].

2.31 SACRISTY SINKS

A. Sacristy Sinks, <Insert drawing designation>:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
      a. Elkay Manufacturing Co.
      b. Just Manufacturing Company.
      c. <Insert manufacturer's name.>
   4. Description: Two-bowl, counter-mounting, stainless-steel fixture.
      a. Size: Approximately [22 by 42 inches (560 by 1070 mm)] <Insert dimensions>.
      b. Cover: Hinged with lock on [left] [right] bowl.
      c. Faucet: <Insert designation.>
      d. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.
      e. Drains: One with stopper and one with grid.
      f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, tubular-brass waste. Include one trap, one direct waste without trap, separate waste piping, and wall flanges.

2.32 OWNER-FURNISHED FIXTURES

A. <Insert fixture type>, <Insert drawing designation>: [Existing, installed] [Existing, remove-and-reinstall] [Used, Owner-furnished] [New, Owner-furnished] fixture.
   1. Provide the following:
      a. Lavatory Faucet: <Insert designation.>
      b. Lavatory, Laminar-Flow Faucet Spout: <Insert designation.>
      c. Bathtub Faucet: <Insert designation.>

d. Bathtub/Shower Faucet: <Insert designation.>
e. Shower Faucet: <Insert designation.>
f. Sink Faucet: <Insert designation.>
g. Sink, Laminar-Flow Faucet Spout: <Insert designation.>
h. Flushometer: <Insert designation.>
i. Toilet Seat: <Insert designation.>
j. Direct-Connected Drain Piping: [NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40)] [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] [chrome-plated, cast-brass] [cast-brass] [plastic] P-trap, and tubular waste to wall with wall flange.
k. Indirect Drain Piping: [NPS 1-1/2 (DN 40)] [NPS 2 (DN 50)] [chrome-plated-brass] [brass or copper] [plastic] tubular waste.
l. Protective Shielding Guard(s): <Insert designation.>
m. Fixture Support: <Insert designation.>
n. Interceptor: <Insert designation.>
o. Shower Receptor: <Insert designation.>
p. Disposer: <Insert designation.>
q. Dishwasher, Air-Gap Fitting: <Insert designation.>
r. Hot-Water Dispenser: <Insert designation.>

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. 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 people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install trap-seal liquid in dry urinals.

P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

S. Install shower flow-control fittings with specified maximum flow rates in shower arms.

T. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

V. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install [in sink deck] [on countertop at sink] <Insert location>. Connect inlet hose to dishwasher and outlet hose to disposer.

W. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.

X. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to

conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

Y. Set [bathtubs] [shower receptors] [and] [service basins] in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

Z. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust [disposers] [hot-water dispensers] [and] [controls]. Replace damaged and malfunctioning units[and controls].

C. Adjust water pressure at [faucets] [and] [flushometer valves] to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

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

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

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SECTION 23 00 00

GENERAL PROVISIONS FOR HEATING, VENTILATING AND AIR CONDITIONING WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for heating, ventilating and air conditioning work covered by all sections within the specifications (including but not limited to HVAC systems and equipment).

B. Contractor shall name AKF as an additional insured on its General Liability insurance policy with respect to liability for bodily injury, property damage, or personal or advertising injury caused in whole or in part by the acts or omissions of Contractor or any of the other additional insureds. The policy shall be primary and non-contributory

C. Provide cutting and patching, except as noted in "AIA Document A210" and "Supplementary Conditions for Mechanical and Electrical Work."

D. Provide piping from plumbing terminations, 10 ft from equipment, for water, gas, compressed air and as indicated.

E. Provide drainage from noted equipment to floor drains, roof, sink, or funnel drains.

F. Provide piping connections to equipment, as required, for kitchens, laboratories, laundries, and as indicated.

G. Related Work And Requirements
1. Requirements of general conditions, supplementary conditions for mechanical and electrical work and Division No. 1.
2. Requirements noted under other Divisions of Work

1.2 WORK NOT INCLUDED:

1. Providing temporary heat.
2. Providing finish painting including pipe stencilling.
3. Providing access doors in concrete for access to fuel-oil tanks.
4. Providing trench covers and frames.
5. Providing chimney cleanout door and thimble.
6. Cutting and patching, except as noted in "AIA Document A201" and "Supplementary Conditions for Mechanical and Electrical Work."
7. Excavating and backfilling under building.
8. Excavating and backfilling.
9. Providing louvers in doors.
10. Providing undercut doors.
11. Providing wall louvers and screens.
12. Providing plenums other than sheet metal.
13. Providing flashing.
14. Providing shaft gratings.

15. Providing equipment platforms.
16. Providing pipe heat tracing system.

1.3 DESCRIPTION OF BID DOCUMENTS

A. Specifications, in general, describe quality and character of materials and equipment.

B. Drawings, in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation. Provide additional offsets, fittings, hangers, supports, valves, drains as required for construction and coordination with work of other trades.

C. Scaled and indicated dimensions are approximate and are for estimating purposes only. Before proceeding with work, check and verify all dimensions.

D. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

E. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans, and are diagrammatic only, but with the intention that such details shall be incorporated in full.

F. If any part of Specifications or Drawings appears unclear or contradictory, consult Architect and/or Engineer for interpretation and decision as early as possible during bidding period. Do not proceed with work without the Architect's and/or Engineer's decision.

1.4 DEFINITIONS

A. "Furnish" or "provide": to supply, install and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount and make complete with all related accessories.

C. "Supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": includes pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and all related accessories.

F. "Wiring": includes raceway, fittings, wire, boxes, and all related accessories.

G. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceilings, trenches, crawl spaces, or enclosures.

H. "Exposed": in view, not installed underground or "concealed" as defined above.

I. "Indicated," "shown," or "noted": as indicated, shown or noted on drawings or specifications.

J. "Similar" or "equal": of base bid manufacturer, equal in quality, materials, weight, size, performance, design and efficiency of specified product, conforming with "Base Bid Manufacturers."

K. "Reviewed," "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by or to Architect and/or Engineer.

L. "Motor Controllers": includes manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

M. "Control or Actuating Devices": includes automatic sensing and switching devices such as thermostats, pressure, float, flow, electro-pneumatic switches and electrodes controlling operation of equipment.

1.5 QUALITY ASSURANCE

A. All equipment and accessories shall be the product of manufacturers regularly engaged in their manufacture. All items of a given type shall be the products of the same manufacturer.

B. Furnish all equipment and accessories new and free from defects.

C. All electrical equipment shall be listed by Underwriters' Laboratories, Inc. (UL) or bear UL labels.

D. Supply all equipment and accessories in complete compliance with and in accordance with the applicable standards listed in reference standards of this Section and with all applicable national, state and local codes.

1.6 JOB CONDITIONS

A. Inspection of Site Conditions:
1. Before starting work, visit the site and examine the conditions under which the work has to be performed. Report in writing any conditions which might adversely affect the work.

1.7 REFERENCE STANDARDS

A. Published specifications, standards tests, or recommended methods of trade, industry or governmental organizations apply to work in all Sections as noted below:
1. ASHRAE - American Society of heating, Refrigerating and Air Conditioning engineers.
2. AABC - Associated Air Balance Controls.
3. AMCA - Air Moving and Conditioning Association.
4. ADC - Air Diffuser Council.
5. NEMA - National Electrical Manufacturers' Association.
6. ANSI - American National Standards Institute.
7. ASME - American Society of Mechanical Engineers.
8. ASTM - American Society for Testing and Materials.
9. NFPA - National Fire Protection Association.
10. ARI - Air-Conditioning and Refrigeration Institute.
11. UL - Underwriters' Laboratories, Inc.
12. OSHA - Occupational Safety and Health Administration Regulations.

1.8 SUBMITTALS

A. Submit shop drawings product data, samples and certificates of compliance required by contract documents, "AIA Document 201" and "SUPPLEMENTARY CONDITIONS FOR MECHANICAL AND ELECTRICAL WORK."

B. Operating instructions, maintenance manuals and parts lists.
   1. Provide manufacturer's equipment brochures and service manuals consisting of the following:
      a. Descriptive literature for equipment and components.
      b. Model number and performance data.
      c. Installation and operating instructions.
      d. Maintenance and repair instructions.
      e. Recommended spare parts lists.
   2. Assemble manufacturers' equipment manuals in chronological order following the specifications' numbering system using heavy duty three ring binders.
   3. Submit valve tag chart.
   4. Submit field test reports including instrument set points and normal operating valves.

1.9 ELECTRONIC COPIES OF AKF DRAWINGS

A. If the contractor requires (.dwg) format, after preparation the drawings will be forwarded only upon receipt of signed acceptance of terms form. Permission from the architect must first be obtained for AKF to include the architectural background as reference. The contractor is to obtain the architects latest drawings directly from the architect.

B. These files are being issued for the convenience of the contractor and the contractor remains responsible for all contract requirements related to the normal shop drawing preparation process.

1.10 SUBMISSIONS:

A. Provide all coordination drawings, ductwork and piping shop drawings in 'AutoCad" format, version compatible with owner. All catalog cuts and submittals to be provided in electronic "PDF" format the architect will forward all submissions to the engineer.

B. If paper submissions are to be provided the following shall be adhered to.
   1. Submissions 11 in. X 17 in. or smaller: If the submission is a catalog cut, then the contractor shall submit one original and one copy. Otherwise, they shall submit two copies. The architect will forward the original and one copy (two copies when no original is received) to the engineer. All catalog cuts shall be complete.
   2. Submissions larger than 11 in. X 17 in.: submit two copies to the architect. The architect will forward to the engineer.

C. Indicate on each submission: project name and location, architect and engineer, item identification and approval stamp of prime contractor, subcontractor names and phone numbers, reference to the applicable design drawing or specification article, date and scale.

D. The work described in all shop drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job.

E. Each submitted shop drawing is to include a certification that all related job conditions have been checked and verified and that there are no conflicts.

F. All shop drawings are to be submitted to allow ample time for checking in advance of field requirements. All submittals to be complete and contain all required and detailed information. Shop drawings with multiple parts shall be submitted as a package.

G. If submittals differ from the contract document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

1.11 AS-BUILTS AND EQUIPMENT OPERATION INSTRUCTIONS

A. Provide all coordination drawings, ductwork and piping shop drawings in AutoCad format, version compatible with owner. All catalog cuts and submittals to be provided in electronic "PDF" format the architect will forward all submissions to the engineer.

B. On completion and acceptance of work, this contractor shall furnish written instructions, equipment manuals and demonstrate to the owner the proper operation and maintenance of all equipment and apparatus furnished under this contract.

C. The contractor shall give one copy of the instructions to the owner and one copy to the engineer. .

D. Final "as-built" drawings indicating as installed conditions shall be provided to the architect and engineer after completion of the installation.

1.12 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping and ductwork is prohibited in electric and telephone rooms and closets, elevator machine rooms, and for installations over or within 5 ft of transformers, substations, switchboards, motor control centers, standby power plants, and motors.

B. Branch piping to equipment is acceptable when installed over or within 5 ft of motors.

1.13 PRODUCT, DELIVERY, HANDLING AND STORAGE

A. Ship materials and equipment in crated sections of sizes to permit passing through available space, where required

B. Deliver equipment with protective crating and shrink-wrapped covering.

C. Receive and accept materials and equipment at the site, properly handle, house, and protect them from damage and the weather until installation. Replace equipment damaged in the course of handling without additional charge.

D. Store to prevent damage and protect from weather, dirt, fumes, water, and construction debris in clean dry space

E. Arrange for and provide storage space or area at the job site for all materials and equipment to be received and/or installed in this project

F. All exposed openings of equipment, piping and ductwork are to be covered

G. Handle according to manufacturer's written rigging and installation instructions for unloading, transporting, and setting in final location

H. Protect units from physical damage. Leave factory shipping covers in place until installation

1.14 ACCESSIBILITY

A. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made without written approval.

B. Group concealed valves, expansion joints, controls, dampers, and equipment requiring access, so as to be freely accessible through access doors.

1.15 PROTECTION OF MATERIALS

A. Protect from damage, water, dust, etc., materials, equipment and apparatus provided under this trade, both in storage and installed

1.16 SUBSTITUTIONS

A. .No substitute material or manufacturer of equipment shall be permitted without a formal written submittal to the engineer which includes all dimensional, performance and material specifications and is approved in writing by the engineer. Any changes in layout or design brought about by the use of a substitution shall be submitted to the engineer fully designed for review in conjunction with the submittal of the alternate. Any substitution must be submitted with an explanation why a substitution is being utilized. If the substitute is being utilized for financial reasons, the associated credit must be simultaneously submitted. Final acceptance or rejection of any substitution is subject to the owner's review.

1.17 STANDARDS:

A. If any item in the specification, as furnished by the contractor, is manufactured in a location which does not certify ASME/ANSI standards, the contractor is to pay the Owner for ALL expenses incurred by the Owner for an outside testing company to confirm such compliance.

1.18 COORDINATION

A. Arrange for pipe spaces, duct spaces, space for equipment, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

D. Provide coordination drawing for all areas of the work. The drawings shall have the following qualities:

1. Minimum 3/8” scale
2. Clearly show all the work for each trade including, but not limited to hangers, valves, dampers, actuators, access doors and service access requirements for all items.
3. Indicate bottom elevations of all ductwork, electrical conduit, raceways, cable trays, control wiring and piping.
4. Ductwork, piping, and conduit 3 inches and smaller may be shown in single line.
5. Ductwork, piping, and conduit greater than 3 inches shall be shown in double line.
6. Color scheme:
   a. Architectural and structural background: Light grey.
   b. Ductwork: Black.
   c. Equipment and pads: Purple.
   d. HVAC piping and equipment: Green.
   e. Electrical conduits and equipment: Blue.
   f. Plumbing: Orange.
   g. Fire protection: Red.
   h. Control wiring: Pink.

1.19 INSPECTIONS / TESTING

A. Independent testing and inspections shall be provided by this contractor who shall hire the inspector or testing agency

1.20 RIGGING

A. This contractor shall provide all required rigging, hoisting and bracing to install the equipment as indicated on the plans. This work shall be performed by an insured certified licensed rigging company that is experienced in rigging equipment of the type indicated for the areas shown on the construction documents. This contractor shall submit rigging plans for approval prior to proceeding with the work.

B. All permits required from the authorities and agencies involved to perform the rigging are the responsibilities of this contractor.

C. All structural supports, modifications or additions are to be submitted to the structural engineer for approval prior to proceeding with the work. All supplemental structural supports, elevator charges /modifications, bracing and protection required for the rig is the responsibility of this contractor

D. The rigging contractor shall hire and pay for all charges and services of the building elevator contractor for the rigging of the equipment

PART 2 - PRODUCTS

2.1 BASE BID MANUFACTURERS

A. Base bid on materials or equipment are specified by name of manufacturer, brand or trade name and catalog reference.

B. The choice will be optional with bidder where two or more manufacturers are named.

C. The following are base bid manufacturers for items under this Section:
   1. Access doors: Karp Associates, Inc., Higgins Mfg. Co., Milcor Steel Co., and Walsh-Spencer Co.
   2. Inserts: F and S Mfg Co., Fee and Mason and Grinnell.
   3. Hangers and supports: I.T.T. Grinnell, Carpenter and Patterson, Inc., and Fee & Mason.

2.2 INSERTS AND SUPPORTS

A. Support all HVAC work from building construction by providing inserts, beam clamps, steel fishplates (in concrete fill only), and acceptable brackets. Submit all methods for review.

B. Provide trapeze hangers of bolted angles or channels for grouped lines and services.

C. Provide additional framing where building construction is inadequate. Submit for review.

D. Inserts shall be steel, slotted type and factory-painted.
   1. Single rod shall be similar to Grinnell Fig. 281.
   2. Multi-rod shall be similar to Fee & Mason Series 9000 with end caps and closure strips.
   3. Clip form nails flush with inserts.
   4. Maximum loading including pipe, contents and covering shall not exceed 75 percent of rated insert capability.

2.3 ACCESS DOORS

A. This contractor shall submit to the architect for approval a plan indicating the size (minimum 18" x 18") and location of all access doors required for operation and maintenance of all concealed equipment, devices, valves, dampers and controls. Contractor shall arrange for furnishing and installation of all access doors in finished construction and include costs in the bid.

B. Access doors will be provided under General Construction Work.

C. Supply access doors for all concealed HVAC items in inaccessible walls and ceilings for complete access, using a with a minimum door size of 12 in. x 12 in. for installation under the General Construction Work. Locating and setting shall be performed after review.

D. Provide access doors for all concealed HVAC items in inaccessible walls and ceilings for complete access, using a minimum door size of 12 in. x 12 in. Locating and setting shall be performed after review.

E. Flush type access doors shall be similar to Karp Type DSC-211 with No. 13 USSG steel doors and trim and No. 16 USSG steel frame, metal wings for keying into construction, concealed hinges and screwdriver operated stainless steel cam lock. Provide lift off type access doors, similar to Karp Type DSC-212, where door cannot swing open.

F. In acoustic tile ceilings, factory finished white access doors shall be similar to Karp Type DSC-210, with No. 13 USSG steel frame, No. 16 USSG steel pan door

suitable for receiving tile thickness and hinges that are not visible when door is closed. Access door shall have screwdriver operated stainless steel cam locks finishing flush with tile with a minimum of 2 per door.

G. In plaster ceilings recessed access doors shall be similar to Karp DSC-210-PL, with recess to receive plaster.

H. In fire rated construction provide fire rated access doors, similar to Karp KRP-150-FR, in accordance with applicable code requirements.

I. Access doors shall have one coat of shop-painted zinc chromate primer.

2.4 NAMEPLATES

A. Provide nameplates with inscriptions, subject to review, indicating equipment and voltage. Fasten with epoxy cement or chrome plated screws. Nameplate shall be black Lamicoid sheet with white lettering.

B. Provide nameplates for gauges, meters, instruments, control devices, pilot lamps, transmitters, motor controllers and panel mounted equipment.

PART 3 - - EXECUTION

3.1 MECHANICAL IDENTIFICATION

A. Refer to identification Section.

3.2 WATERPROOFING

A. Waterproofing will be provided under General Construction Work.

3.3 FIELD QUALITY CONTROL

A. Perform tests as noted, and in the presence of Architect and/or Engineer and authorities having jurisdiction.

B. Provide required labor, material, equipment, and connections necessary for tests and submit results for review.

C. Repair or replace defective work and pay for restoring or replacing damaged work due to tests, as directed.

D. Tests and instruction: Refer to specification Division 23 Testing Adjusting and Balancing for HVAC.

3.4 CLEANING

A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.

B. Clean and repair painted exposed work, soiled or damaged, to match adjoining work before final acceptance.

C. Remove debris from inside and outside of material and equipment.

END OF SECTION

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SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Sleeves.
4. HVAC demolition.
5. Equipment installation requirements common to equipment sections.
6. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Brazing: Before proceeding, submit the following for review and approval;
   1. Proposal procedure conforming to latest revision of:
      a. Section IX, ASME boiler and pressure vessel code, welding and brazing qualifications.
      b. ANSI/AWS B2.2 Standard for Brazing Procedure and Performance Qualification
   2. List of brazers qualified per section IX of ASME. Boiler and Pressure Vessel Code including, but not limited to, the following information:
      1) Brazer's name
      2) Brazer's Social Security Number
      3) Employer's name
      4) Name of testing laboratory
      5) Procedure tested for including, but not limited to, the following:
         a) Date of test
         b) Wall thickness
         c) Base metal material
         d) Brazing filler material
         e) Position
      6) Type of test performed
      7) Result of test
      8) Brazer's identification symbol
      9) Sample of each identification device
      10) Certify that each Brazer has either worked in the procedure or successfully tested in the procedure within the past six months
      11) BPQ
      12) PQR
      13) BPS

1.5 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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 to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless 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. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
   1. Underdeck Clamp: Clamping ring with set screws.

C. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

D. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated and rough brass.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated and rough brass.

D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.6 GROUT

A. General Purpose Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 14000 / 19000-psi (34.5-MPa), 36 hours @70 degrees compressive strength.
   3. Packaging: factory packaged for field mixing.

B. Pump Mounting: High flow, high strength epoxy machine-based grout: ASTM C 881, CRD-C 590.
   1. Characteristics: Two to Three-component, highly flowable, epoxy-based grout that produces high performance strength plus chemical inertness and excellent bonding properties.
   2. Design Mix: ASTM-C 579, 14,000 / 19,000 psi , 36 hours @72 degree F compressive strength.
   3. Packaging: Factory packaged for field mixing.
   4. Products: Chocfast by ITW Philadelphia resins, ESCOWELD or approved equal.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   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 (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
         1) Seal space outside of sleeve fittings with grout.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

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SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. The mechanical contractor is to provide motor, motor controllers and VFD's. The mechanical contractor to install motor, motor controllers and VFD's. The Electrical contractor is to wire all motors, motor controllers and VFD's

1.3 COORDINATION

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

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with

indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

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

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.

1.3 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.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

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 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

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

B. Locate equipment labels where accessible and visible.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
   2. HVAC equipment quantitative-performance settings.
   3. Verifying that automatic control devices are functioning properly.

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 indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. 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.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

L. 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.

M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

O. 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.

P. TAB: Testing, adjusting, and balancing.

Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

R. Test: A procedure to determine quantitative performance of systems or equipment.

S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

C. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

D. Sample Report Forms: Submit two sets of sample TAB report forms.

E. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, NEBB, or TABB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
    a. Submittal distribution requirements.
    b. The Contract Documents examination report.
    c. TAB plan.
    d. Work schedule and Project-site access requirements.
    e. Coordination and cooperation of trades and subcontractors.
    f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing."

E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with 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 TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: Provide a guarantee on NEBB TABB forms stating that NEBB TABB will assist in completing requirements of the Contract Documents if TAB firm

fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
   2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, 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 HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

E. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

F. Examine equipment for installation and for properly operating safety interlocks and controls.

G. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of 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. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   5. Sensors are located to sense only the intended conditions.

6. Sequence of operation for control modes is according to the Contract Documents.
7. Controller set points are set at indicated values.
8. Interlocked systems are operating.
9. Changeover from heating to cooling mode occurs according to indicated values.

H. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare 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 indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" 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 insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure 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 component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
3. 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.
4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

3.5 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.6 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. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the interaction of electrically operated switch transducers.

G. Check the interaction of interlock and lockout systems.

H. Check main control supply-air pressure and observe compressor operations.

I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.7 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.

3.8 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: 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.

3.9 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB firm who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Other system operating conditions that affect performance.

E. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Number of filters, type, and size.
2. Motor Data:
    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm (L/s).
    b. Filter static-pressure differential in inches wg (Pa).

F. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Unit make and model number.
    d. Compressor make.
    e. Compressor model and serial numbers.
    f. Refrigerant weight in lb (kg).
    g. Low ambient temperature cutoff in deg F (deg C).
2. Test Data (Indicated and Actual Values):
    a. Inlet-duct static pressure in inches wg (Pa).
    b. Outlet-duct static pressure in inches wg (Pa).
    c. Entering-air, dry-bulb temperature in deg F (deg C).
    d. Leaving-air, dry-bulb temperature in deg F (deg C).

e. Control settings.
f. Unloader set points.
g. Low-pressure-cutout set point in psig (kPa).
h. High-pressure-cutout set point in psig (kPa).
i. Suction pressure in psig (kPa).
j. Suction temperature in deg F (deg C).
k. Condenser refrigerant pressure in psig (kPa).
l. Condenser refrigerant temperature in deg F (deg C).
m. Oil pressure in psig (kPa).
n. Oil temperature in deg F (deg C).
o. Voltage at each connection.
p. Amperage for each phase.
q. Kilowatt input.
r. Crankcase heater kilowatt.
s. Number of fans.
t. Condenser fan rpm.
u. Condenser fan airflow rate in cfm (L/s).
v. Condenser fan motor make, frame size, rpm, and horsepower.
w. Condenser fan motor voltage at each connection.
x. Condenser fan motor amperage for each phase.

G. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.10 INSPECTIONS

A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
a. Measure airflow of at least 10 percent of air outlets.
b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Verify that balancing devices are marked with final balance position.
d. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Axial roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Submit the family of rpm curves indicating operating point relative to fan class.
   3. Drive construction and rating.
   4. Catalog cuts and dimension drawings.
   5. Submit all selected sheave (fan and motor) calculations.
   6. Correction chart for fans equipped with variable inlet vanes indicating performance at various percentage of opening.
   7. VFD application: Submit fan selection with system curve indication, operating point, family of all rpm curves in fan class and the "DO NOT SELECT TO THE LEFT OF THIS CURVE". The minimum rpm shall be indicated.
   8. Certified fan sound-power ratings.
   9. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   10. Material thickness and finishes, including color charts.
   11. Dampers, including housings, linkages, and operators.
   12. Roof curbs.
   13. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. 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.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

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

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
1. Test and rate all fans in accordance with the standards of AMCA. All fans shall bear the AMCA rating and seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Make appropriate allowances for the effects on fan performance of all installation conditions including plenum enclosures and inlet and discharge arrangements so that actual installed fan performance equals that specified.

B. Fans shall be non-overloading and operate stably without surging at design conditions.

C. Fan characteristic curves provided by manufacturer must be such that that the fan operating point:
   1. Is to the right of peak efficiency.
   2. Is on the steep part of the fan curve such that an increase in static pressure over the specified duty results in not more than the same percent decrease in volume (CFM) and does not affect the stability of fan operation.
   3. Is no greater than 60 to 70 percent of the peak static pressure.
   4. Has the ability to provide an allowable increase in fan speed of 15 percent above the design point without surging or increasing the class of fan.

D. Provide non-overloading design, except as noted with minimum capacities as noted and with certified ratings by AMCA. Where variable inlet vanes are used, complete assembly shall be factory installed by the fan manufacturer. The fan horsepower performance characteristics shall be within 5 percent of published catalog rating data of the standard fan without the variable inlet vanes, where no data is available for the fan with inlet vanes. Inlet vanes shall be capable of reducing flow to 20 percent of design cfm at 1-1/2 inch w.g. static pressure and maintain stable performance. Inlet vanes and all operating linkages shall be provided and assembled by fan manufacturer prior to shipment to job site.

E. Wheel shall be factory balanced statically and dynamically. Brake horsepower ratings shall be 5 percent maximum above those noted and published for a minimum of two (2) years.

F. Motor pulley shall be variable pitch diameter, for fans up to 25 hp and 1000 rpm, except fans with variable inlet vanes and VFD's use fixed pitch, and fixed pitch diameter, over 25 hp or 1000 rpm. Supply and install one fixed pitch pulley change, as required, per fan to balance systems. Companion sheaves shall maintain belts parallel. Belt guards shall be in compliance with OSHA regulations and with tachometer opening for fan speed measurements. Manufacturer shall provide replacement fixed pitched sheaves where needed to balance system.

G. Provide removable flanged screens at inlets or outlets where no connecting ductwork is indicated, including inlets to fans in field erected casings.

H. Bearings shall be ball, roller or taper. Provide pressure type lubricating fittings with pressure relief fittings extended to accessible locations. lubricating fittings shall be similar to Alemite. Pressure relief fittings shall be similar to Keystone. For fans 27 inch and larger, provide housings horizontally split, roller bearings.

I. Provide spark resistant construction fans in accordance with AMCA Standards Type A, B or C. Type A: All where noted, parts in contact with air shall be non-ferrous. Type B shall be non-ferrous fan wheel and shaft rings. Type C shall be with non-ferrous inlet cone and rubbing plate. Motor shall be explosion proof, Class I, Group D, Division 2. Belt drive shall be non-sparking.

J. Split construction: Provide split construction for fans too large for available doorways or passageways. Split in half along center of shaft with angles, etc., to allow removal of section without disturbing inlet and discharge connection; arranged for bolting. Provide bolts with lockwashers and nuts. Construction shall

be inspected by manufacturer after field assembly and certified that they have been properly assembled and ready for proper operation.

K. The drive end of the fan shaft shall be countersunk for tachometer readings.

L. For all fans located outdoors, except roof ventilators exposed to the weather, provide custom fitted weather guards completely enclosing the fan motor, drive and bearings. Provide weatherproof louvers in the enclosure to permit circulation of air but to exclude rain and snow. Arrange one side of the enclosure to be completely removable for access to motors, drives, bearings and other equipment located within requiring maintenance. Construct the enclosure of 16 gauge aluminum, braced with aluminum angles. Paint the fan exterior with two coats of weatherproof aluminum paint.

2.2 DIRECT DRIVE HOODED ROOF PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerovent; a Twin City Fan Company.
2. Greenheck.
3. Loren Cook Company.
4. New York Blower Company (The).

B. General Description:
1. Fan arrangement shall be exhaust
2. Roof mounted applications
3. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius)
4. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number

C. Wheel:
1. Wheel shall be steel blades with welded gussets to steel hubs
2. Securely attached to fan shaft
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The propeller and fan inlet will be matched

D. Motors:
1. AC Induction Motor
   a. Motor Enclosure: Totally enclosed fan cooled (TEFC) - no opening in the frame or brackets. Equipped with an external fan to blow air over the motor.
   b. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
   c. Accessible for maintenance

E. Drive Frame:
1. Drive frame assemblies shall be galvanized steel
2. Formed channels and fan panels shall have a deep formed one piece inlet venturi
3. Bolted structural steel channels and one piece motor plate

F. Fan Base and Hood:
1. Material Type: Aluminum
2. Hood panels are arched with interlocking standing seams for weather protection
3. Supporting members are galvanized steel angles

4. Base height is unit size specific with pre-punched mounting holes for installation

G. Fan Panel:
1. Constructed of heavy gauge steel with formed flanges and a deep spun venturi

H. Birdscreen:
1. Constructed of ½ inch galvanized steel mesh
2. Mounted horizontally across the discharge/intake area of the hood

I. Accessories:
1. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.
   a. Configuration: Self-flashing without a cant strip, with mounting flange.
   b. Overall Height: 12 inches (300 mm).
   c. Damper Access extension: Provide 8" aluminum extension with removable access panel.
2. Backdraft Damper:
   a. Prevents outside air from entering back into the building when fan is off
   b. Galvanized frames with prepunched mounting holes
3. Hood Insulation:
   a. Lined with 1 inch fiberglass insulation to prevent condensation and sound levels
4. Lifting Lugs:
   a. Four heavy gauge steel brackets to provide lifting points when raising the fan to the roof
5. Damper Access extension: Provide 8" aluminum extension with removable access panel.

2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. 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 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using spring isolators.

C. Secure roof-mounting fans to roof curbs.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Install ducts adjacent to power ventilators to allow service and maintenance.

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Balance all fan wheels and all other moving components statically and dynamically. Where a coating is specified and it affects the balance of the fan wheel, perform the balancing after the coating has been applied.
   9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   10. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
   11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
   12. For units with variable frequency drives lock out critical frequencies before initial start.
   13. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   14. Replace fan and motor pulleys as required to achieve design airflow.
   15. Shut unit down and reconnect automatic temperature-control operators.
   16. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Lubricate bearings.

END OF SECTION

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SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

G. LEED Submittals:
1. Credit EA 4: Manufacturers' product data for refrigerants, including printed statement that refrigerants are free of HCFCs.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mitsubishi Electronics America, Inc.; HVAC Division.
   2. Trane Company (The); Unitary Products Group.
   3. York International Corp.

2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct drive, centrifugal fan.

E. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Filters: Permanent, cleanable.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and

mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   1. Compressor Type: Scroll.
   2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   3. Refrigerant Charge: R-410A.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).

H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
   1. Compressor time delay.
   2. 24-hour time control of system stop and start.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection, including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Additional Monitoring:
   1. Monitor constant and variable motor loads.
   2. Monitor variable frequency drive operation.
   3. Monitor economizer cycle.
   4. Monitor cooling load.
   5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install wall-mounting, compressor-condenser components on steel wall supports provided by equipment manufacturer.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION

SECTION 26 00 00

GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for the following:
   1. Electrical work covered by all Sections within DIVISION 26 of the Specifications, including, but not limited to electrical systems and equipment.
   2. RACEWAY
   3. WIRE AND CABLE
   4. LOW VOLTAGE DISTRIBUTION EQUIPMENT
   5. POWER, CONTROL AND ALARM WIRING SYSTEMS
   6. GROUNDING SYSTEM
   7. DEVICES
   8. LIGHTING FIXTURES
   9. ELECTRICAL PROVISIONS FOR SECURITY AND BUILDING AUTOMATION SYSTEMS
   10. DOOR SECURITY SYSTEM
   11. ELECTRICAL PROVISIONS FOR FIRE AND LIFE SAFETY
   12. FIRE ALARM SYSTEM
   13. TESTING
   14. LOCAL NURSE CALL CONDUIT SYSTEM.
   15. SECURITY CONDUIT SYSTEM.

B. Provide cutting and patching, except as noted in "AIA document A201" and "Supplementary Condition for Mechanical and Electrical Work".

C. Related Work and Requirements
   1. Requirements of GENERAL CONDITIONS and Division No. 1.
   2. Requirements noted under HVAC, Plumbing, Fire Protection, Transportation and Automated Monitoring & Control

1.2 WORK NOT INCLUDED:

A. Providing temporary light and power.

B. Providing finished painting.

C. Providing access doors and filler.

D. Installing access doors and providing filler.

E. Cutting and patching, except as noted in "AIA Document A210" and "Supplementary Conditions for Mechanical and Electrical Work."

F. Supplying and setting motors.

G. Excavating and backfilling under building.

H. Excavating and backfilling.

1.3 DESCRIPTION OF BID DOCUMENTS

A. Specifications describe quality and character of materials and equipment.

B. Drawings are diagrammatic and indicate general arrangement of systems and work. Follow drawings in laying out work and check drawings of other trades to verify space conditions. Maintain headroom and space conditions.

C. Scaled and figured dimensions are approximate and are for estimate purposes only. Before proceeding with work, check and verify all dimensions.

D. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

E. Typical details, where shown on the drawings, apply to each item of the project where such items are applicable. Typical details are not repeated on the plans.

F. If Specifications or Drawings appear unclear or contradictory, consult the Architect and/or Engineer for interpretation as early as possible during bidding period. Do not proceed with work without Architect's and/or Engineer's decision.

1.4 DEFINITIONS

A. "Provide": to supply, install, and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount, and make complete with all related accessories.

C. "Furnish" or "supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.

F. "Wiring": raceway, fittings, wire, boxes and all related accessories.

G. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceilings, trenches, crawl spaces, or enclosures.

H. "Exposed": in view, not installed underground or "concealed" as defined above.

I. "Indicated," "shown," or "noted": as indicated, shown, or noted on drawings or specifications.

J. "Similar" or "equal": of base bid manufacture, equal in quality materials, weight, size, performance, design, and efficiency of specified product, conforming with "Base Bid Manufacturers."

K. "Reviewed" "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by Architect and/or Engineer.

L. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

M. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow, operation of equipment.

1.5 QUALITY ASSURANCE

A. All work shall combine with National Electrical Code and all applicable local codes.

B. Furnish all materials and equipment new, free from defects and with listings or labels of Underwriter's Laboratories, Inc. or other nationally approved testing laboratory.

C. All items of a given type shall be the product of the same manufacturer.

D. All materials and equipment shall be the product of manufacturers regularly engaged in their manufacture.

E. Current characteristics:
   1. Provide the following interior building distribution:
      a. 120/208 volt, 3 phase, 4 wire, 60 Hz with grounded 4W distribution. 277/480 volt, 3 phase, 4 wire, 60 Hz with grounded 4W distribution.
      b. 480 volt, 3 phase, 3 wire, 60 Hz.

F. Equipment ampere ratings shall be for continuous operation in 104oF (40oC) ambient temperature unless otherwise indicated.

G. Provide the following heights of outlets and verify with Architect and/or Engineer prior to installation:
   1. From finished floor to centerline of outlets for:
      a. Receptacles and telephones:
         1) Generally 1'-6"
         2) Over work benches 3'-6"
      b. Wall switches:
         1) Generally 4'-0"
      c. Wall fixtures 7'-0"
      d. Motor controllers 5'-0"
      e. Gongs and horns 7'-6"
      f. Gongs and horns 8’-0”
      g. Fire alarm stations 3'-6"
      h. Strobe lights 6’-8”
   2. The following are exceptions to specified height of outlets:
      a. At junction of different wall finish materials.
      b. On molding or break in wall surface.
      c. In violation of Code.
      d. As noted or directed.

1.6 JOB CONDITIONS

A. Inspection of Site Conditions.
   1. Before starting work, visit the site and examine the conditions under which the work has to be performed. Report in writing any conditions which might adversely affect the work.

B. Connections to existing work:
   1. Install new work and connect to existing work with minimum interference to existing facilities.

2. Provide temporary shutdowns of existing services at no additional charges and only with written consent of Owner. Schedule shutdowns not to interfere with normal operation of existing facilities.
3. Alarm and emergency systems shall not be interrupted.
4. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
5. Connect new work to existing work in neat and acceptable manner. Restore existing disturbed work to original condition including maintenance of wiring continuity required.
6. Perform the following work only after regular working hours:
   a. Coordinate scope of off hour work with owner prior to beginning work

C. Removal and relocation of existing work:
1. Disconnect, remove, or relocate electrical material, equipment, and other work noted and required by alterations, modifications, or changes in existing construction.
2. Provide new material and equipment required for relocated equipment.
3. Disconnect load and line end of conductor feeding existing equipment.
4. Tape both ends of abandoned conductors and cap outlets and abandoned raceways.
5. Remove any raceway no longer required for removed or relocated equipment.
6. Return removed electrical equipment to owner as directed, and dispose of other equipment.
7. Dispose of removed electrical equipment as directed.

D. Hazardous locations:
1. Provide required material, equipment and installation for hazardous locations.
2. Provide material, equipment, and installation as required for Class, Division and Group noted.
3. Provide material, equipment, and installation meeting requirements of National Electric Code Class, Division and Group, except Division 1 requirements apply to Division 2.

1.7 REFERENCE STANDARDS

A. Published specifications, standards, tests, or recommended methods of trade, industry or governmental organizations apply to work in all sections as noted below:
1. NEMA - National Electrical Manufacturers' Association.
2. ANSI - American National Standard Institute.
3. IEEE - Institute of Electrical & Electronics Engineers.
4. NFPA - National Fire Protection Association
5. UL - Underwriter's Laboratories, Inc.
6. OSHA - Occupational Safety and Health Administration Regulations.

1.8 SUBMITTAL

A. Submit shop drawings and samples in accordance with "AIA Document 201" and "Supplementary Conditions for Mechanical and Electrical Work."

B. Operating instructions, equipment maintenance manuals and parts lists.
1. Before requesting acceptance of work, submit one set for review by the Architect and/or Engineer.

2. Provide five sets of manufacturers' equipment brochures and service manuals consisting of the following:
   a. Descriptive literature for equipment and components.
   b. Model number and performance data.
   c. Installation and operating instructions.
   d. Maintenance and repair instructions.
   e. Recommended spare parts lists.
3. Assemble manufacturers' equipment manuals in chronological order following the specifications alpha-numerical system using heavy duty three ring binders.
4. Submit three detailed and simplified one line, color coded wiring diagrams.
5. Submit three sets of field test reports

1.9 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Ship materials and equipment in crated sections of sizes to permit passing through available space, where required.

B. Receive and accept materials and equipment at the site, properly handle, house, and protect them from damage and the weather until installation. Replace equipment damaged in the course of handling without additional charge.

C. Arrange for and provide storage space or area at the job site for all materials and equipment to be received and/or installed in this project.

1.10 ACCESSIBILITY

A. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made without written approval.

B. Install equipment requiring access so as to be freely accessible through access doors.

1.11 CUTTING AND PATCHING:

A. Provide all carpentry, cutting and patching required for proper installation of material and equipment specified. Do not cut or drill structural members without consent of architect and structural engineer.

B. All cutting and patching will be performed under General Construction Work, except as noted in "AIA Document A201" and "Supplementary Conditions for Mechanical and Electrical Work."

1.12 PROTECTION OF MATERIALS

A. Protect from damage, water, dust, etc. all material, equipment and apparatus provided under this trade both in storage and installed.

1.13 GUARANTEE

A. The Contractor shall furnish a written guarantee to replace or repair promptly and assume responsibility for all expenses incurred for any workmanship and equipment

in which defects develop within one year from the date of final certificate for payment and/or from date or actual use of equipment or occupancy of spaces by Owner included under the various parts of the work, whichever date is earlier. This work shall be done as directed by the Owner. This guarantee shall also provide that where defects occur, the Contractor will assume responsibility for all expenses incurred in repairing and replacing work of other trades affected by defects, repairs or replacements in equipment supplied by the Contractor.

1.14 PERMITS AND FEES

A. The Contractor shall give necessary notice, file drawings and specifications with the department having jurisdiction, obtain permits or licenses necessary to carry out this work and pay all fees therefor. The Contractor shall arrange for inspection and tests of any or all parts of the work if so required by authorities and pay all charges for same. The Contractor shall pay all costs for, and furnish to the Owner before final billing, all certificates necessary as evidence that the work installed conforms with all regulations where they apply to this work.

PART 2 - PRODUCTS

2.1 BASE BID MANUFACTURERS

A. Base bid on materials or equipment are specified by name of manufacturer, brand or trade name and catalog reference.

B. The choice will be optional with bidder where two or more manufacturers are named, but only with the manufacturers listed.

C. Manufacturers, other than specified, will only be considered if at the time of bid, manufacturers' names and proposed substitutions are named and stated and the difference in base bid is indicated including changes in the cost of all affected work. This must be approved by owner, architect and engineer prior to submitting bid.

D. Submission of equipment of manufacturers other than specified shall detail equality and difference item by item. Delay in ordering of equipment will not be considered a valid cause for substitution.

E. The following are base bid manufacturers for items under this Section:
   1. Access doors: Karp Associates, Inc., Higgins Mfg. Co., Milcor Steel Co. and Walsh-Spencer Co.
   2. Inserts: F and S Mfg. Co., Fee and Mason and Grinnell.

2.2 INSERTS AND SUPPORTS

A. Inserts:
   1. Inserts will be provided under General Construction Work.
   2. Provide additional acceptable means of support attachments as required, after review.
   3. Provide cutting and patching required to install additional attachments.

B. Support all electrical work from building construction by providing inserts, beam clamps, steel fishplates (in concrete fill only), and acceptable brackets. Submit all methods for review. Inserts shall be steel slotted type, factory painted.
   1. Single rod shall be similar to Grinnell Fig. 281.

2. Multi-rod shall be similar to Fee Mason Series 9000 with end caps and closure strips.
3. Clip form nails flush with inserts.
4. Maximum loading including conduit, contents and covering shall not exceed 75% of rated insert capability.

C. Provide smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 Type 1, Class 3.

D. Provide trapeze hangers of bolted angles or channels for grouped lines and services.

E. Provide additional framing where building construction is inadequate. Submit for review.

F. Do not exceed 1/4 of average valves for a specific anchor size using 2000 psig (13,800 kpa) concrete only, for maximum working loads.

G. Provide spacing and install anchors in accordance with the manufacturer's recommendations.

H. Provide supports from building construction including inserts, beam clamps steel fishplates (in concrete fill only) cantilever brackets or other means. Submit for review.

2.3 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

A. Furnish supplementary steel, channels, and supports required for proper installations, mounting, and support of electrical work.

B. Connect supplementary steel and channels firmly to building construction in an accepted manner.

C. Determine type and size of supporting channels and supplementary steel. Supplementary steel and channels shall be of sufficient strength and size to allow only a minimum deflection in conformance with manufacturers' requirements of loading.

D. Install supplementary steel and channels in a neat and workmanlike manner parallel to walls, floors, and ceiling construction.

E. All supplementary steel, channels and supports shall be submitted to the Structural Engineer for review and approval.

2.4 ACCESS DOORS

A. Access doors will be provided under General Construction Work.

B. Supply access doors as required for complete access. Installation shall be under General Construction Work. Minimum size shall be 12 in. x 12 in. Locating and setting will be performed after review.

C. Provide for access doors as required for complete access. Minimum size shall be 12 in. x 12 in. Locating and setting will be performed after review.

D. Flush type access doors shall be similar to Karp Type DSC-211 for wall installation, with No. 13 USSG steel doors and trim and No. 15 USSG steel frame, metal wings for keying into construction, concealed hinges and screwdriver operated stainless

steel cam lock. Lift off type access door shall be similar to Karp Type DSC-212 where door cannot swing open.

E. Factory finished white access doors shall be similar to Karp Type DSC-210 in acoustic tile ceilings, with NO. 13 USSG steel frame, No. 16 USSG steel pan door suitable for receiving tile thickness and hinges that are not visible when door is closed. Access doors shall be screwdriver operated, stainless steel cam locks finishing flush with tile with a minimum of (2) per door.

F. Access doors shall be similar to Karp DSC-210-PL in plaster ceilings, with recess to receive plaster.

G. Fire rated access doors shall be similar to Karp KRP-150-FR, in accordance with applicable code requirements.

H. Access doors shall be shop-painted zinc chromate primer.

2.5 ACCESS TILE IDENTIFICATION:

A. Provide buttons, tabs or markers in removable ceiling tiles to identify location of concealed work. Submit for review.

2.6 NAMEPLATES:

A. Provide nameplates with inscriptions, subject to review, indicating equipment and fasten with epoxy cement and engrave black Lamicoid sheet with white lettering.

B. Provide nameplates for the following:
1. Disconnect switches.
2. Individual circuit breakers.
3. Panels.
4. Cabinets
5. Motor Controllers.

PART 3 - EXECUTION

3.1 PAINTING

A. Provide labor, materials and equipment necessary for field prime painting and apply in accordance with manufacturers' instructions.

B. Apply zinc based primer with finish to match surroundings, to marred surfaces of steel equipment and raceways.

C. Apply galvanized iron primer on panel and pull boxes, after fabrication.

D. Apply hot dip galvanizing or dip in zinc based primer: outlet boxes, junction boxes, conduit hangers, rods, inserts, and supports.

E. Field apply zinc based primer coat on non-galvanized steel and iron work.

3.2 FOUNDATIONS

A. Foundations will be provided under General Construction Work.

B. Provide foundations utilizing concrete as specified herein:

1. Provide one portland cement, two parts fine aggregate, and four parts course aggregate.
2. Provide concrete of the same consistency as specified under General Construction Work.
3. Provided concrete, poured in place on roughened concrete floor, cleaned and flushed with coat of cement grout. Do not pour grout until concrete has set. Foundation shall be puddled and finished smooth with reinforcing as noted.
4. Provide floor free foundation forms and special foundations as noted.

C. Hold vibration isolation and anchor bolts in position during pour. Set anchor bolts in oversized sleeves with washers and nuts at bottom. Finish flush with nuts on top.

D. Foundations shall extend 6 in. beyond equipment, except as noted, with a minimum height of 4 in.

E. Forms:
1. Forms will be provided under General Construction Work.
2. Provide moisture-resistant commercial standard fir with non-staining mineral oil interior surface coating with rounded or chamfered edges.
3. Provide galvanized NO. 18 USSG steel forms with welded seams & joints with bent top and bottom edges to form 2 in. integral internal angles (bend back exposed edges) and metal cross-strip bracing, welded to top and bottom angle edges, and intermediate bracing welded or riveted to sides as required.
   a. Bottoms for floor free foundations.

F. Provide foundations for the following:
1. Floor mounted transformers.
2. Switchboards.
3. Floor mounted automatic transfer switches.
4. As noted.

3.3 FIELD QUALITY CONTROL

A. Perform tests as noted, and in the presence of the Architect and/or Engineer in accordance with authorities having jurisdiction.

B. Provide required labor, materials, equipment, and connections necessary for tests and submit for review.

C. Repair or replace defective work, as directed and pay for restoring or replacing damaged work of others, due to tests, as directed.

3.4 CLEANING

A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.

B. Clean and repair painted exposed work, soiled or damaged, to match adjoining work before final acceptance.

C. Remove debris from inside and outside of materials and equipment.

D. All electrical and communication rooms shall be broom swept and cleaned.

END OF SECTION

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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in "Penetration Firestopping."."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Basis-of-Design Product: Subject to compliance with requirements, comparable product by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Link-Seal
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in "Penetration Firestopping."

END OF SECTION

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

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

C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Insulated Wire Corp.; a Leviton Company.
   2. General Cable Corporation.
   3. Senator Wire & Cable Company.
   4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN and XHHW.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, AC-hospital grade (HFC-90) with copper ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide sleeve seals or a comparable product by one of the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.

3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.
5. Link Seal

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type AC-hospital grade (HFC-90). All branch circuits in electric rooms shall be in conduit. Conduit shall run to box located outside electric room. Splicing not allowed in box, extend conductors to panel.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
      a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
      b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of

deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Ground rings.
   4. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
   1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B
      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

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

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC

D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inches (6 by 100 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. Use for bonding to steel and as indicated.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).
1. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and voice/data equipment rooms, in rooms housing service equipment, and elsewhere as indicated. Length 24" or as indicated in drawings.
   1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

E. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

B. Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.

C. Drive ground rods until tops are 12 inches (300 mm) below finished grade in undisturbed earth.

D. Ground-Rod Connections: Install bolted connectors for underground connections and connections to rods.

E. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

F. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.

G. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-

shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
   9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
   10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-24-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least [three] <Insert number> rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange.

Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column extending around the perimeter of building.
1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches (600 mm) from building foundation.

J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 2AWG.
1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include

the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10ohms.
   2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Sections include the following:
   1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project,.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. For handholes and boxes for underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.
      b. Frame and cover design.
      c. Grounding details.
      d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
      e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For professional engineer and testing agency.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Allied Tube & Conduit; a Tyco International Ltd. Co.
   3. Electri-Flex Co.
   4. O-Z Gedney; a unit of General Signal.
   5. Wheatland Tube Company.

C. Rigid Steel Conduit: ANSI C80.1.

D. Aluminum Rigid Conduit: ANSI C80.5.

E. IMC: ANSI C80.6.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: ANSI C80.3.

H. FMC: Zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket.

J. Fittings for Conduit (Including all Types for Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
   2. Fittings for EMT: Steel or die-cast type.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 METAL WIREWAYS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper B-Line, Inc.
   2. Hoffman.
   3. Square D; Schneider Electric.

C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Flanged-and-gasketed type.

F. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thomas & Betts Corporation.
      b. Walker Systems, Inc.; Wiremold Company (The).
      c. Wiremold Company (The); Electrical Sales Division.

2.4 BOXES, ENCLOSURES, AND CABINETS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Hoffman.
4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
5. O-Z/Gedney; a unit of General Signal.
6. RACO; a Hubbell Company.
7. Thomas & Betts Corporation.
8. Walker Systems, Inc.; Wiremold Company (The).

C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy aluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

F. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

J. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.6 SLEEVE SEALS

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

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.

D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   2. Pressure Plates: Stainless steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: EMT.
   2. Concealed Conduit, Aboveground: EMT.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: EMT. Includes raceways in the following locations:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: Galvanized Rigid steel conduit.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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SECTION 26 05 36

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes aluminum, stainless, steel, and fiberglass cable trays and accessories.

1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
   2. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
      a. Design Calculations: Calculate requirements for selecting seismic restraints.
      b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

C. Coordination Drawings: Floor plans and sections, drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements. Show the following:
   1. Vertical and horizontal offsets and transitions.
   2. Clearances for access above and to side of cable trays.
   3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

D. Field quality-control reports.

E. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

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

C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Aluminum cable tray, Stainless-steel cable tray, Fiberglass cable tray may be stored outside without cover, but shall be loosely stacked, elevated off the ground, and ventilated to prevent staining during storage.

B. Store indoors to prevent water or other foreign materials from staining or adhering to cable tray. Unpack and dry wet materials before storage.

C. Field Painted cable tray shall be stored indoors. Protect cable tray from scratching and marring of finish. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chalfant Manufacturing Company.
2. Cooper B-Line, Inc.
3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
4. GS Metals Corp.; GLOBETRAY Products.
5. MONO-SYSTEMS, Inc.
6. MPHusky.
7. PW Industries.

2.2 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
1. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment; with Type 316 stainless-steel hardware

B. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with Type 316 stainless-steel splice-plate fasteners, bolts, and screws

C. Cable Trays, Fittings, and Accessories: Stainless steel, Type 316, complying with NEMA VE 1.

D. Cable Trays, Fittings, and Accessories: Fiberglass, complying with NEMA FG 1 and UL 568. Splice-plate fasteners, bolts, and screws shall be fiberglass-encapsulated stainless steel. Design fasteners so that no metal is visible when fully assembled and tightened. Fastener encapsulation shall not be damaged when torqued to manufacturer's recommended value.

E. Sizes and Configurations: Refer to the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
   1. Center-hanger supports may be used only when specifically indicated.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Covers: Louvered type of same materials and finishes as cable tray.

C. Barrier Strips: Same materials and finishes as cable tray.

D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WARNING SIGNS

A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA FG 1, and NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure and install seismic restraints.
   1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Seismic Controls for Electrical Systems."
   2. Place supports so that spans do not exceed maximum spans on schedules.
   3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
   4. Support bus assembly to prevent twisting from eccentric loading.
   5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
   6. Locate and install supports according to NEMA FG 1,and NEMA VE 1.

D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA FG 1, and NEMA VE 1. Space connectors and set gaps according to applicable standard.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

I. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

J. Workspace: Install cable trays with enough space to permit access for installing cables.

K. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

L. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.2 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

D. In existing construction, remove inactive or dead cables from cable tray.

E. Install covers after installation of cable is completed.

3.3 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.4 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.5 PROTECTION

A. Protect installed cable trays.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION

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SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Isolation pads.
   2. Spring isolators.
   3. Restrained spring isolators.
   4. Channel support systems.
   5. Restraint cables.
   6. Hanger rod stiffeners.
   7. Anchorage bushings and washers.

B. Related Sections include the following:
   1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
   2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [I] [II] [III].
      a. Component Importance Factor: 1.0
      b. Component Response Modification Factor: 1.5
      c. Component Amplification Factor: 1.0
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 5%.
   4. Design Spectral Response Acceleration at 1.0-Second Period: 3%

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
    a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

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

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

D. Pads. Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.

E. Spring Isolators Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-(6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-(6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

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

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.
9. <Insert manufacturer's name>.

D. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other

matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

G. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

H. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

K. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

L. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:
   1. Install restrained isolators on electrical equipment.
   2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. Verify snubber minimum clearances.
   9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Identification for raceway and metal-clad cable.
   2. Identification for conductors and communication and control cable.
   3. Warning labels and signs.
   4. Instruction signs.
   5. Equipment identification labels.
   6. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage, if applicable.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength: 50 lb (22.6 kg), minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
   1. Exterior Ferrous Metal:
      a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
         1) Primer: Exterior ferrous-metal primer.
         2) Finish Coats: Exterior semigloss alkyd enamel.
   2. Exterior Zinc-Coated Metal (except Raceways):
      a. Semigloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
         1) Primer: Exterior zinc-coated metal primer.
         2) Finish Coats: Exterior semigloss alkyd enamel.
   3. Interior Ferrous Metal:
      a. Semigloss Acrylic-Enamel Finish: One finish coat(s) over a primer.
         1) Primer: Interior ferrous-metal primer.
         2) Finish Coats: Interior semigloss acrylic enamel.
   4. Interior Zinc-Coated Metal (except Raceways):
      a. Semigloss Acrylic-Enamel Finish: One finish coat(s) over a primer.
         1) Primer: Interior zinc-coated metal primer.
         2) Finish Coats: Interior semigloss acrylic enamel.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Raceways More Than 600 V Concealed within Buildings: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches (50 mm) high, with snap-around labels. Repeat legend at 10-foot (3-m) maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl tape applied in bands.

D. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
   1. Fire Alarm System: Red.
   2. Fire-Suppression Supervisory and Control System: Red and yellow.
   3. Security System: Blue and yellow.
   4. Mechanical and Electrical Supervisory System: Green and blue.
   5. Telecommunication System: Green and yellow.
   6. Control Wiring: Green and red.

E. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

F. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use write-on tags. Identify each ungrounded conductor according to source and circuit number.

G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

K. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer or load shedding.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   2. Equipment to Be Labeled: All equipment requires a label 94D shall include but not limited to:
      a. Panelboards, electrical cabinets, and enclosures.
      b. Access doors and panels for concealed electrical items.
      c. Electrical switchboards.
      d. Transformers.
      e. Emergency system boxes and enclosures.
      f. Enclosed circuit breakers.
      g. Motor starters.
      h. Push-button stations.
      i. Power transfer equipment.
      j. Voice and data cable terminal equipment.
      k. Fire-alarm control panel and annunciators.

l. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
m. Monitoring and control equipment.
n. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
o. Automatic Transfer Equipment.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeders, and branch-circuit conductors.
1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:
a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
3. Colors for 480/277-V Circuits:
a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

I. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION

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SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
   1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals [shall] [may] be in digital form.
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Study and Equipment Evaluation Reports.
   3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert computer software developer's name; product name or designation> or a comparable product by one of the following:
1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.
6. <Insert computer software developer's name.>

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
1. Optional Features:
   a. Arcing faults.
   b. Simultaneous faults.
   c. Explicit negative sequence.
   d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
   a. Circuit-breaker and fuse-current ratings and types.
   b. Relays and associated power and current transformer ratings and ratios.
   c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
   d. Generator kilovolt amperes, size, voltage, and source impedance.
   e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
   f. Busway ampacity and impedance.
   g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Generator thermal-damage curve.
   e. Ratings, types, and settings of utility company's overcurrent protective devices.
   f. Special overcurrent protective device settings or types stipulated by utility company.
   g. Time-current-characteristic curves of devices indicated to be coordinated.
   h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
   1. Switchgear and switchboard bus.
   2. Medium-voltage controller.
   3. Motor-control center.
   4. Distribution panelboard.

5. Branch circuit panelboard.
6. <Insert significant locations in system.>

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with [IEEE 141] [IEEE 241] and IEEE 242.
1. Transformers:
   a. ANSI C57.12.10.
   b. ANSI C57.12.22.
   c. ANSI C57.12.40.
   d. IEEE C57.12.00.
   e. IEEE C57.96.
2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- [and high-]voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with [IEEE 141] [IEEE 241] [IEEE 242] recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time switches.
   2. Outdoor photoelectric switches.
   3. Indoor occupancy sensors.
   4. Outdoor motion sensors.
   5. Lighting contactors.
   6. Emergency shunt relays.

B. Related Sections include the following:
   1. Division 16 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

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

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
2. Leviton Mfg. Company Inc.
3. Lightolier Controls; a Genlyte Company.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Square D; Schneider Electric.
6. TORK.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Contact Configuration: SPST
2. Contact Rating: 30-A inductive or resistive, 240-V ac.

C. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
1. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
2. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
3. Astronomic Time: All channels.
4. Battery Backup: For schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
2. Lithonia Lighting; Acuity Lighting Group, Inc.
3. Novitas, Inc.
4. Square D; Schneider Electric.
5. TORK.

B. Description: Solid state, with SPST dry contacts rated for [800-VA tungsten or 1000-VA inductive to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.

3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR PHOTOELECTRIC SWITCHES

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc.
2. Lithonia Lighting; Acuity Lighting Group, Inc.
3. MicroLite Lighting Control Systems.
4. Novitas, Inc.
5. Paragon Electric Co.; Invensys Climate Controls.
6. Square D; Schneider Electric.
7. TORK.
8. Touch-Plate, Inc.
9. Watt Stopper (The).
10.

C. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20A ballast load at 120- and 277-V ac, for 1hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lx), with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.4 OUTDOOR MOTION SENSORS (PIR)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Paragon Electric Co.; Invensys Climate Controls.
5. TORK.
6. Watt Stopper (The).
7. <Insert manufacturer's name.>

B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as raintight according to UL 773A.

1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
   b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
3. Bypass Switch: Override the on function in case of sensor failure.
4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc (11 to 215 lx); keep lighting off during daylight hours.

C. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

D. Detection Coverage: Up to 52.5 feet (16 m), with a field of view of 270 degrees

E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.

F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.5 LIGHTING CONTACTORS

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

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. GE Industrial Systems; Total Lighting Control.
5. Grasslin Controls Corporation; a GE Industrial Systems Company.
6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
8. MicroLite Lighting Control Systems.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).

D. Description: Electrically operated and mechanically held, combination type with fusible switch complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices as indicated on Drawings], matching the NEMA type specified for the enclosure.

2.6 LIGHTING CONTROL RELAYS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide ASCO 917 with accessories or a comparable product by one of the following:
   1. Allen-Bradley/Rockwell Automation.
   2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
   3. Eaton Electrical Inc.; Cutler-Hammer Products.
   4. GE Industrial Systems; Total Lighting Control.
   5. Square D; Schneider Electric.

C. Description: Electrically operated and mechanically held..
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices matching the NEMA type specified for the enclosure.

2.7 EMERGENCY SHUNT RELAY

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

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings or a comparable product by one of the following:
   1. Lighting Control and Design, Inc.
   2. Wattstopper

D. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
   1. Coil Rating: 277 V.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. During business hours. Provide up to [two] <Insert number> visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.
   2. Buck-boost transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

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

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
   2. Eaton Electrical Inc.; Cutler-Hammer Products.

3. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
4. General Electric Company.
5. Hammond Co.; Matra Electric, Inc.
6. Magnetek Power Electronics Group.
7. Olsen Transformers
8. Siemens Energy & Automation, Inc.
9. Sola/Hevi-Duty.
10. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.
1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: ANSI 61 gray.

F. Taps for Transformers Smaller Than 3 kVA: [None].

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:
   a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
   b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
   c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

M. Wall Brackets: Manufacturer's standard brackets.

N. Fungus Proofing: Permanent fungicidal treatment for coil and core.

O. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

P. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
1. 9 kVA and Less: 40dBA
2. 30 to 50 kVA: 45dBA
3. 51 to 150 kVA: 50dBA
4. 151 to 300 kVA: 55dBA
5. 301 to 500 kVA: 60dBA
6. 501 to 750 kVA: 62dBA
7. 751 to 1000 kVA: 64dBA

2.4 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.

B. Enclosure: Ventilated, NEMA 250, Type 2.
1. Finish Color: ANSI 61 gray.

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
   3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

D. Qualification Data: For qualified Installer.

E. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field Quality-Control Reports:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

G. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. 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.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:
1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner’s written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

C. Front-Connected, Front-Accessible Switchboards:
   1. Main Devices: Panel mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.

D. Front- and Side-Accessible Switchboards:
   1. Main Devices: Fixed, individually mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.

E. Nominal System Voltage: 480Y/277 V

F. Main-Bus Continuous: 1200 A.

G. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

H. Indoor Enclosures: Steel, NEMA 250, Type 1

I. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray over a rust-inhibiting primer on treated metal surface.

J. Barriers: Between adjacent switchboard sections.

K. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

L. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
   1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
   2. Space-Heater Power Source: Transformer, factory installed in switchboard.

M. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

N. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

O. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

P. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

Q. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

R. Pull Box on Top of Switchboard:
   1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
   2. Set back from front to clear circuit-breaker removal mechanism.
   3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
   4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
   5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

S. Buses and Connections: Three phase, four wire unless otherwise indicated.
   1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated aluminum or copper feeder circuit-breaker line connections.
   2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
   3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, or tin-plated, high-strength, electrical-grade aluminum alloy.
   4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
   5. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-)] [1/4-by-1-inch- (6-by-25-mm-)] hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
   6. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
   7. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
   8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
   9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

T. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

U. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

V. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

C. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
   1. Fuses, rated at 200-kA interrupting capacity.
   2. Fabrication using bolted compression lugs for internal wiring.
   3. Integral disconnect switch.
   4. Redundant suppression circuits.
   5. Redundant replaceable modules.
   6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
   7. LED indicator lights for power and protection status.
   8. Audible alarm, with silencing switch, to indicate when protection has failed.
   9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   10. [Four] [Six]-digit, transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA per phase.

E. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

F. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277V, three-phase, four-wire circuits shall be as follows:
   1. Line to Neutral: 800 V for 480Y/277.
   2. Line to Ground: 800 V for 480Y/277.
   3. Neutral to Ground: 800 V for 480Y/277.

G. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:
   1. Line to Neutral: 400 V, 800 V from high leg.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

H. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:
   1. Line to Line: 2000 V for 480 V
   2. Line to Ground: 1500 V for 480 V

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.

b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
   g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): 80percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Standard function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time time adjustments.
   c. Ground-fault pickup level, time delay, and I^2t response.
4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: 120-V ac.

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Megawatts: Plus or minus 2 percent.
e. Megavars: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

D. Instrument Switches: Rotary type with off position.
1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

E. Feeder Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

F. Watt-Hour Meters and Wattmeters:
1. Comply with ANSI C12.1.
2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
3. Suitable for connection to three- and four-wire circuits.
4. Potential indicating lamps.
5. Adjustments for light and full load, phase balance, and power factor.
6. Four-dial clock register.
7. Integral demand indicator.
8. Contact devices to operate remote impulse-totalizing demand meter.
9. Ratchets to prevent reverse rotation.
10. Removable meter with drawout test plug.
11. Semiflush mounted case with matching cover.
12. Appropriate multiplier tag.

G. Impulse-Totalizing Demand Meter:
1. Comply with ANSI C12.1.

2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording [five] [15] [30] <Insert time period>-minute integrated demand of totalized system.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
B. Control Circuits: 120-V ac, supplied from remote branch circuit.
C. Control Circuits: 24V dc.
D. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
E. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
F. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.7 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
   1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
   1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install switchboards and accessories according to NEMA PB 2.1.
B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
F. Install filler plates in unused spaces of panel-mounted sections.
G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
H. Install spare-fuse cabinet.
I. Comply with NECA 1.

3.3 CONNECTIONS
A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.
B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Hospital grade receptacles
5. Tamper proof receptacles
6. Snap switches
7. Ceiling and Wall Mounted occupancy sensors.
8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor service outlets installed, but no fewer than two.
   2. Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   2. Leviton Mfg. Company Inc. (Leviton).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL5351 (single), CR5352 (duplex).
      b. Leviton; 5891 (single), 5352 (duplex).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL8300SG.
      b. Leviton; 8300-SGG.

2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
   1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
   2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL5362SA.
      b. Leviton; 5380.
   2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.4 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; GF20.
      b. Hubbell.

C. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement SD.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL8362SA.
      b. Leviton; 8380.
   2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Hubbell; HBL2310.
      b. Leviton; 2310.

2.6 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
b. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

2.7 OCCUPANCY SENSORS

A. Wall and Ceiling Occupancy Sensors:
1. Products: Subject to compliance with requirements, provide one of the following manufacturers. Refer to drawings for acceptable model numbers.
a. Leviton Manufacturing Company Inc. (Leviton)
2. Description: 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.8 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035 inch thick, satin finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. Wiring Devices Connected to Optional Stand-by: Blue.
4. Isolated-Ground Receptacles: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:
      a. Cut back and pigtail, or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
   8. Tighten unused terminal screws on the device.
   9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
   2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
   1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
   2. Test Instruments: Use instruments that comply with UL 1436.
   3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, and enclosed controllers
   2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   3. Current-limitation curves for fuses with current-limiting characteristics.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
   4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C)] , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Bussmann, Inc.
   2. Ferraz Shawmut, Inc.

2.2 CARTRIDGE FUSES

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

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.

3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
1. Motor Branch Circuits: Class RK1, time delay.
2. Other Branch Circuits: Class RK1, time delay.
3. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Fusible switches.
2. Shunt trip switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to so that. "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

SUBMITTALS

B. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

C. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.

D. Qualification Data: For qualified testing agency.

E. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, 600-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open (where indicated on drawings).
   5. Lugs: Mechanical type, suitable for number, size, and conductor material.
   6. Service-Rated Switches: Labeled for use as service equipment.

2.2 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I^2t response.

F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

H. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact (where indicated on drawings).
   6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay (where indicated on drawings).
   7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts (where indicated on drawings).
   8. Alarm Switch: One NO/NC contact that operates only when circuit breaker has tripped.
   9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position (where indicated on drawings).

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
5. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 or Type 9.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

3. Perform ouver current trip test for circuit breaers over 200amps based on HEMA standards. The use of secondary injection for solid state trip devices shall be for trip settings of 200 amps up to 400A. Provide primary injection testing for trip settings over 400 amps.

E. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 265100

LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Lighting fixtures and drivers.
   2. Exit signs.
   3. Lighting fixture supports.

B. Related Sections include the following:
   1. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. CU: Coefficient of utilization.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture including driver.

E. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. LED Drivers
   3. Energy-efficiency data.
   4. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
   5. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers, and Grilles."
   6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
1. Wiring Diagrams: Power and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.
4. Other items in finished ceiling including the following:
.
a. Speakers.
b. Sprinklers.
c. Smoke and fire detectors.
d. Occupancy sensors.
5. Perimeter moldings.

D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Product Certificates: For each type of bi-level and dimmer-controlled fixtures, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for lighting fixtures.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

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

D. Comply with NFPA 70.

E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
   1. Obtain Architect's approval of fixtures for mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Drivers: Manufacturer's standard form in which driver manufacturer agrees to repair or replace driver/fixture that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for LED Drivers: Five years from date of Substantial Completion.

1.8 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. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Comply with UL 8750.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. 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.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:
1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 LED LUMINARES AND DRIVERS

A. All Luminaires
1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
2. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
3. Comply with In-Situ testing for more reliable results.
4. LED’s shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
5. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
6. LED luminaires shall deliver a minimum of 60 lumens per watt.
a. LED’s shall be “Bin No. 1” quality
7. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.

8. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
9. LED color temperatures: CRI> 85, 2700K as noted +/- 145K.
10. LED color temperatures: CRI> 85, 4000K as noted +/- 275K.
11. LED color temperatures: CRI> 85, 5000K as noted +/- 283K.
12. Luminaires shall have internal thermal protection.
13. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
14. Color spatial uniformity shall be within .004 of CIE 1976 diagram.
15. Color maintenance over rated life shall be within .007 of CIE 1976.
16. Indoor luminaires shall have a minimum CRI of 85.
17. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
18. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
19. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

B. Power Supplies and Drivers
1. Power Factor: 0.90 or higher
2. Maximum driver case temperature not to exceed driver manufacturer recommended operation.
3. Output operating frequency: 60Hz.
4. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
5. Total Harmonic Distortion Rating: 20% Maximum.
6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.
7. Primary Current: Confirm primary current with Drawings.
8. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
9. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
10. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

C. Controller and Control System
1. System electronics driver / controller to use coordinated communication protocols: 0-10V, or proprietary as required
2. The Contractor to ensure that external control equipment is compatible with LED control requirements
3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
4. For control components that are part of overall area control system see Dimming

2.4 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Wires for Humid Spaces: ASTM A 580/A 580M, 316, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
   1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
   2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

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SECTION 27 05 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the premise telecommunications cabling system.

B. As a condition of Contractor's use of these specifications, Contractor agrees (i) to name AKF as additional insured on Contractor's insurance policies wherever permitted, (ii) to provide AKF, upon request, with a certificate of insurance and copies of specific endorsements to Contractor's insurance policies evidencing said additional insured status, and (iii) to waive all rights of recovery against AKF by way of subrogation, assignment, or otherwise with regard to insured claims.

C. Related Sections include the following:
1. Division 26 Electrical Sections
2. Division 1 Sections

D. The work covered by this specification includes the construction described, including all labor necessary to perform and complete such construction; all materials and equipment incorporated or to be incorporated in such construction; and all services, facilities, tools and equipment necessary or used to perform and complete such construction.
1. F&I all workstation jacks, connectors, terminating devices, faceplates, and similar components required for a complete installation.
2. F&I all cable supports (J-hooks), including mounting and installation hardware required for a complete installation.
3. F&I all labeling and documentation of all cables, racks, outlets and hardware installed under this contract. The Contractor shall ensure that all labeling and numbering is in accordance with the Owner's in-house standards.
4. Provide all testing and test documentation as described in the testing section.
5. Label and document all new and existing-to-remain cables.
6. Provide all connections to the telecommunications grounding system.
7. Provide all fire-stopping of all rated wall and floor penetrations and openings through rated walls and floors after installation of telecommunications cabling.
8. F&I all non-specified miscellaneous hardware, including, but not limited to nuts, bolts, re-enterable cable ties, spiral wrap, wire rings, supporting hardware and similar components required for a complete cabling system installation.

9. Certain terms such as "shall, provide, install, complete, etc." are not used in some parts of these Specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

B. Field Test Reports

1.4 QUALITY ASSURANCE

A. Furnish all materials in new and unused condition, free from defects, damage or corrosion. All materials shall meet all applicable codes provided a standard has been established for the material in question.

B. Comply with all applicable governmental regulations and with all Federal, State, County, City, and other applicable codes, ordinances, and regulations and the most recent edition of the following technical standards and design guidelines:
1. ANSI/NECA/BICSI-568 Standard for Installing Commercial Building Telecommunications Cabling (latest edition).
2.
3. ANSI/TIA/EIA-606 Administration Standard for Commercial Telecommunications Infrastructure (latest edition).
4.
5. ANSI J-STD-607 Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (latest edition).
6.
7. ANSI/NECA/BICSI-568, Standard for Installing Commercial building Telecommunications Cabling, (latest edition).
8.
9. BICSI, Telecommunications Distribution Methods Manual (latest edition).

C. It is the intent of these Specifications to provide a complete workable telecommunications cabling system including optical fiber, coaxial and unshielded twisted pair cable, and ready for the Owner's use.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials (except bulk materials) in manufacturer's unopened container, fully identified with manufacturer's name, trade name, type, grade, size and color.

B. Store materials suitably sheltered from the elements, but readily accessible for inspection until installed. Store all items subject to moisture damage in dry, climate controlled spaces.

C. Store all materials in a secure manner to prevent loss. Contractor shall be responsible for any loss or damage of materials prior to Owner's acceptance thereof.

1.6 COORDINATION

A. Carefully check space requirements and the physical confines of the area of work to insure that all material can be installed in the spaces allotted thereto.

B. Transmit to other trades in a timely manner all information required for work to be provided under their respective Sections in ample time for installation.

C. Wherever work interconnects with or contacts the work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the floor tile trade will know where to install tile cutouts.

D. When directed by the Owner, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper compliance with the design intent.

1.7 WARRANTY

A. Provide a Warranty in accordance with the Contract Documents.

B. All work and all items of equipment and materials shall be warranted for a minimum period of one year from the date of acceptance of the work. Where manufacturer's warranty is longer than one year, the Contractor shall offer the extended warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. Any given item of equipment or material shall be the product of one manufacturer unless otherwise noted or approved.

B. Substitutions or alternates for the manufacturers listed will not be permitted without the written consent of the Consultant.

PART 3 - EXECUTION

3.1 GENERAL

A. Follow manufacturers' instructions for installing all telecommunications cabling. Where instructions are unavailable, follow approved industry practice.

B. Compare communications drawings and specifications with the drawings and specifications of other trades, report any discrepancies to the Consultant; and obtain written instructions for changes necessary in the work. Include most stringent requirements in bid.

C. Repairs or changes caused by contractor's neglect shall be made at contractor's expense. Protect finished work of other trades from damage or defacement and remedy any damages as required.

D. Clean up all debris generated by installation activities and discard as directed by the Construction Manager.

E. Maintain a current copy of this Specification and related Drawings at the job site at all times.

3.2 CABLE DISTRIBUTION

A. Follow room boundaries when pulling cables through ceilings for distribution into walls, conduits, wiring channels, outlets, etc.

B. All cable distribution from the communications closets to all work locations (except as noted) shall be run in the voids above ceilings as shown on drawings. Ceiling support grids and service hangers shall not be used to support cabling.

C. Cable shall be loose bundled into cable supports. Use only approved re-enterable cable ties to secure cables in overhead distribution.

3.3 EMI/RFI AVOIDANCE

A. To avoid electromagnetic interference (EMI) route cables to maintain the following minimum distances:

B. Twelve inches from high voltage lighting.

C. Thirty-six inches from power lines of 5 KVA or greater.

D. Forty inches from transformers or motors.

E. Maintain minimum twelve-inch separation between telecommunication cables running exposed in ceiling or floor voids and parallel electrical cables/conduits.

F. Telecommunication cables shall cross electrical cables/conduits only at 90 degree angles.

3.4 STAFFING

A. Designate a qualified foreman. The foreman shall be present in the field at all times during the performance of the work.

B. Provide a supervisory work force sufficient to maintain efficient performance of the contractor’s responsibilities.

C. Use only skilled and reliable work force and discontinue the services of anyone employed on this project upon written request by the Owner, Architect, Construction Manager or Consultant.

D. Use personnel who are qualified (at minimum) to perform all of the installation and testing work activities required under the contract.

E. Provide and use the proper tools in good working order for the performance of the work. The Consultant reserves the right to review the tools and tool maintenance procedures of the contractor and require replacements to be obtained.

F. Telephone and data industry cable installation standards, TIA/EIA and BICSI standards, and manufacturers’ instructions shall be used for in-process quality control and final acceptance of the work.

3.5 CABLE SLACK

A. Provide a minimum of 12-inches of slack at each terminal box or behind each faceplate after jack installation is completed to allow for easy dismounting and extension of outlet covers and wire terminations.

B. Provide a minimum of 2-feet slack in a loop in UTP at the head of each stub-up or distribution conduit.

C. Provide a minimum of 8-feet slack in a loop in optical fiber cable at its point of entry to an equipment room.

D. Provide a minimum of 20-feet slack for overhead mounted Wireless Access Point outlets.

3.6 FIRE STOPPING

A. Seal all penetrations through fire rated walls, floors and walls created by or made on the behalf of the contractor so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electric Code.

B. Use sealant material that has passed fire exposure testing in accordance with standard time-temperature curve in the standard, UL, ASTM E 119, and NFPA 251 and the hose stream test in accordance with UL 1OB.

Provide removable fire-stopping pillows (IPC flame safe seal bags or approved equivalent) in an approved fashion in openings greater than 4” diameter, or 4” x 4” square cross section. Provide wire mesh grate over bags as recommended by manufacturer subsequent to installation.

END OF SECTION

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SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

1.2 SCOPE OF WORK

A. This section includes the minimum requirements for the equipment and cable installations in communications equipment rooms (Telecommunications Closets).

B. Included in this section are the minimum composition requirements and installation methods for the following:
   1. Busbars
   2. Bonding accessories

1.3 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufactures listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

C. Material and work specified herein shall comply with the applicable requirements of:
   1. ANSI/TIA/EIA – 568-B Commercial Building Telecommunications Cabling Standard, 2000-2004
   2. TIA – 569-B Commercial Building Standard for Telecommunications Pathways and Spaces, 2004
   3. ANSI/TIA/EIA – 606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2002
   4. ANSI-J-STD – 607-B Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, latest edition.
   5. NFPA 70 – National Electric Code, latest edition.
   6. BICSI – Telecommunications Distribution Methods Manual, latest edition.

1.4 SUBMITTALS

A. Provide product data for the following:

1. Manufacturers cut sheets, specifications and installation instructions for all products (submit with bid).

PART 2 - PRODUCTS

2.1 WALL-MOUNT BUSBARS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Chatsworth Products, Inc.
   2. Panduit Corp.
   3. Erico

B. Telecommunications Main Grounding Busbar (TMGB)
   1. Telecommunications Main Grounding Busbar (TMGB) shall be constructed of .25" (6.4 mm) thick solid copper bar.
   2. The busbar shall be 4" (100 mm) high and 20" (510 mm) or longer and shall have multiple attachment points for two-hole grounding lugs.
   3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A
   4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" (100 mm) standoff from the wall.
   5. The busbar shall be UL Listed as grounding and bonding equipment.

C. Telecommunications Grounding Busbar (TGB)
   1. Telecommunications Grounding Busbar (TGB) shall be constructed of .25" (6.4 mm) thick solid copper bar.
   2. The busbar shall be 2" (50 mm) high and 12" (300 mm) long and shall have multiple attachment points for two-hole grounding lugs.
   3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD – 607-A and shall accept multiple lugs with 5/8" (15.8 mm) and 1" hole centers.
   4. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" (100 mm) standoff from the wall.
   5. The busbar shall be UL Listed as grounding and bonding equipment.

2.2 BONDING ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Chatsworth Products, Inc.
   2. Panduit Corp.
   3. Erico

B. Two Mounting Hole Ground Terminal Block
   1. Ground terminal block shall be made of electroplated tin aluminum extrusion.
   2. Ground terminal block shall accept conductors ranging from #14 AWG through 2/0.
   3. The conductors shall be held in place by two stainless steel set screws.

4. Ground terminal block shall have two 1/4" (6.4 mm) holes spaced on 5/8" (15.8 mm) centers to allow secure two-bolt attachment to the rack or cabinet.
5. Ground terminal block shall be UL Listed as a wire connector.

C. Compression Lugs
1. Compression lugs shall be manufactured from electroplated tinned copper.
2. Compression lugs shall have two holes spaced on 5/8" (15.8 mm) or 1" (25.4 mm) centers, as stated below, to allow secure two bolt connections to busbars.
3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 4/0.
4. Compression lugs shall be UL Listed as wire connectors.

D. Antioxidant Joint Compound
1. Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.

E. C-Type, Compression Taps
1. Compression taps shall be manufactured from copper alloy.
2. Compression taps shall be C-shaped connectors that wrap around two conductors forming an irreversible splice around the conductors; installation requires a hydraulic crimping tool
3. Compression taps shall be sized to fit specific size conductors, sizes #2 AWG to 4/0.
4. Compression taps shall be UL Listed.

F. Pedestal Clamp With Grounding Connector
1. Pedestal clamp shall be made from electroplated tinned copper or bronze. Installation hardware will be stainless steel.
2. Pedestal clamps shall be sized to fit a specific size conductor, size #6 and/or 2/0, as stated below.
3. Pedestal clamp installation hardware shall be sized to attach to round and/or square raised access floor pedestals that are 1-1/8" to 1-3/4" in diameter, as stated below.
4. Pedestal clamp shall provide straight (in-line) or cross (intersection) support for up to two conductors.
5. Pedestal clamp shall be UL Listed as grounding and bonding equipment.

G. Pipe Clamp With Grounding Connector
1. Pipe clamp shall be made from electroplated tinned bronze. Installation hardware will be stainless steel.
2. Pipe clamp shall be sized to fit up to two conductors ranging in size from #6 to 250 MCM; conductors must be the same size.
3. Pipe clamp installation hardware shall be sized to attach to pipes, sizes 1" to 6" (.75" to 6.63" in diameter), as stated below.
4. Pipe clamp shall be UL Listed as grounding and bonding equipment.

H. Equipment Ground Jumper Kit
1. Kit includes one 24"L insulated ground jumper with a straight two hole compression lug on one end and an L-shaped two hole compression lug on the other end, two plated installation screws, an abrasive pad and a .5 once tube of antioxidant joint compound.
2. Ground conductor is an insulated green/yellow stripe #6 AWG wire

3. Lugs are made from electroplated tinned copper and have two mounting holes spaces .5" to .625" apart that accept 1/4" screws.
4. Jumper will be made with UL Listed components

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mount Busbars
1. Attach busbars to the wall with appropriate hardware according to the manufacturer's installation instructions.
2. Conductor connections to the TMGB or TGB shall be made with two-hole bolt-on compression lugs sized to fit the busbar and the conductors.
3. Each lug shall be attached with stainless steel hardware after preparing the bond according to manufacturer recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.
4. The wall-mount busbar shall be bonded to ground as part of the overall Telecommunications Bonding and Grounding System.

B. Ground Terminal Block
1. Every rack and cabinet shall be bonded to the TMGB or TGB.
2. Minimum bonding connection to racks and cabinets shall be made with a rack-mount two-hole ground terminal block sized to fit the conductor and rack and installed according to manufacturer recommendations.
3. Remove paint between rack/cabinet and terminal block, clean surface and use antioxidant between the rack and the terminal block to help prevent corrosion at the bond.

C. Pedestal Clamp
1. At minimum, bond every sixth raised access floor pedestal with a minimum #6 AWG conductor to the TMGB or TGB using a pedestal clamp sized to fit the pedestal and the conductor and installed according to the manufacturer's recommendations.
2. If pedestal clamps are used to construct a signal reference grid, bond the signal reference grid to the TMGB or TGB and bond each rack and/or cabinet to the signal reference grid using a compression tap or similar non-reversible bonding component sized to fit both conductors.
3. Remove paint between the pedestal and pedestal clamp, clean surface and use antioxidant between the pedestal and the clamp to help prevent corrosion at the bond.
4. Remove insulation from conductors where wires attach to the pedestal clamp.

D. Pipe Clamp
1. Bond metal pipes located inside the data center computer room with a minimum #6 AWG conductor to the TMGB or TGB using a pipe clamp sized to fit the pipe and the conductor and installed according to the manufacturer's recommendations.
2. Remove paint between the pipe and pipe clamp, clean surface and use antioxidant between the pipe and the clamp to help prevent corrosion at the bond.
3. Remove insulation from conductors where wires attach to the pipe clamp.

E. Equipment Ground Jumper Kit
   1. Bond equipment to a vertical rack-mount busbar or groundbar using ground jumper according to the manufacturer's recommendations.
   2. Clean the surface and use antioxidant between the compression lugs on the jumper and the rack-mount busbar or groundbar to help prevent corrosion at the bond.

END OF SECTION

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SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Telecommunications mounting elements
   2. Backboards.
   3. Telecommunications equipment racks and cabinets
   4. Telecommunications service entrance pathways

B. Related Sections:
   1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
   2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
   3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches (152 mm) in width.

D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.

H. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
   3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Qualification Data: layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
   3. Field Inspector: Currently registered by BICSI as RCDD Commercial Installer, Level 2 to perform the on-site inspection.

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. Telecommunications Pathways and Spaces: Comply with ANSI/TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-C.

E. Labeling of all Telecom components shall be in accordance with/ANSI/TIA/EIA-606(A).

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.8 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner and/or their agent to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute them to other participants.
   3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
   4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 CABLING & PATCH PANELS

A. Cat6A Patch Panels
   1. Ortronics OR-PHD6AU48 (2U)
   2. Ortronics OR-60400199 (Strain Relief Bar)

B. Cat6A 4-pair UTP Cabling - Green
   1. Berk-Tek LANmark 10G2 CAT6A (Color Green for IS)
   2. Berk-Tek LANmark 10G2 (Color Orange for CL Data Room)

2.2 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets. Contractors shall note that the use of plastic cable ties is strictly prohibited.
   1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
   2. Support brackets with cable tie slots for fastening cable ties to brackets.
   3. Lacing bars, spools, J-hooks, and D-rings.
   4. Straps and other devices.

C. Ladder Rack, Supports & Accessories:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. CPI
         1) 18” Ladder Rack (Black): 10250-718

2) Rung Radius Drop: 12100-712
3) Stringer Radius Drop: 12101-701
4) 6” Cable Retaining Posts: 10596-706
5) 15”W Corner Bracket: 11959-715
6) Provide supports, splice kits and grounding as required.

2. Ladder Rack Materials: Metal, suitable for indoors and protected against corrosion.
   a. Trays shall be provisioned 18” wide.
   b. Ladder rack shall be manufactured from 3/8” W by 1 1/2” H tubular steel,
   c. Ladder rack cross members shall be welded in between stringers on 9” centers.
   d. Finish shall be epoxy-polyester hybrid powder coat – black in color.
   e. Contractor shall be responsible for furnishing all supports fittings and transition pieces (water falls).

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems. Flexible metal conduit shall not be used.
   1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.3 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm) shall be installed in all telecom spaces as noted and/or required to complete the overall scope of work. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

B. All backboards shall be furred out from the wall with 2x4 dimensional lumber as detailed on the drawings.

2.4 EQUIPMENT CABINETS, RACKS & ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Chatsworth Products, Inc.
      a. 19" 2-Post Equipment Rack (Black): 46053-703
      b. 6"W Double-sided Vertical Cable Manager (Black): 11729-703
      c. Rack Installation Kit (Concrete): 40604-001
      d. 2U Upper Jumper & Transition Tray: 12183-719

   2. Ortronics
      a. 2U Horizontal Cable Manager:OR-60400426

   3. Great Lakes (If required)
      a. 84”H x 24”W x 36”D Network Cabinet w/ Mesh Front Door, Split Mesh Rear Doors & Vented Top: GL840E-2436MSP
      b. Casters: 7208-E
      c. #10-32 Mounting Rails (quantity 2-pair per cabinet): 8405-ES1P
      d. #10-32 Screws: as required

   4. Rack Solutions
      a. Adjustable Sliding Shelf: 1USHL-115

5. Tripp-lite
   a. 12-Port KVM Switch w/ IP Access: B020-016-17-IP

B. General Requirements:
1. Server Cabinets: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat – color black.

C. Floor-Mounted Racks: Modular-type, aluminum construction.
1. Vertical and horizontal cable management channels, top cable trough, grounding lug, and associated power strips.
2. Baked-polyester powder coat finish.

D. Cable Management for Equipment Frames:
1. Metal, ring duct for cabling.
2. Baked-polyester powder coat finish (Black).
3. Vertical cable management panels shall have front and rear channels.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each. Horizontal manage panel shall be arranged so that one panel is above and below each contractor provided patch panel.

2.5 POWER STRIPS

A. Power Strips: Contractor Furnished & Installed
1. Vertically rack mounted, monitored w/ L5-20P input:
   a. Geist VRTBC200-15210TL

2. 1RU Horizontally mounted ATS w/ two (2) 5-20P inputs:
   a. Tripp-Lite PDUMH20ATNET

2.6 UPS:

A. Rack-mounted UPS Units: Contractor Furnished & Installed
1. 2.2kVA On-Line Double-Conversion, 2RU w/ 5-20P input for Clinical Engineering Tech Room (40107):
   a. Tripp-Lite SU2200RTXL2UA
2. 2.2kVA On-Line, 2RU w/ 5-20P input for Network Room (40109):
   a. APC SURTA2200RMXL2U

2.7 LABELING

A. Comply with ANSI/TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Each new server cabinet and equipment rack shall have custom engraved, phenolic labels, front and rear.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

3.2 Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems" installation.

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Cable Trays: Comply with NEMA VE 2 and ANSI/TIA/EIA-569-A-7.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with ANSI/TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-C.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with ANSI/TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems. "Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of ANSI/TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with ANSI/TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.

C. Labels shall be preprinted or computer-printed type.

END OF SECTION

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SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pathways
   2. UTP cable
   3. Optical fiber cabling
   4. Cable connecting hardware, patch panels, and cross-connects
   5. Cabling identification products

B. Related Sections:
   1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

C. UTP Backbone Infrastructure – Contractors shall supply and install, in the pair counts as denoted on the provided drawings, all copper UTP backbone riser cabling between each identified Telecom Room and the Main Server Room (see drawings for exact location). Contractors shall be responsible for providing and installing all components necessary to complete this scope of work. This work shall include but not be limited to all: termination hardware, cable supports, cable management (troughs, D-Rings or Velcro), cross-connect wiring, or any additional hardware needed for routing backbone cabling between the identified locations.

D. Fiber Optic Backbone Infrastructure – Contractors shall supply and install multimode laser-optimized 50/125µm (OM3) optical fiber riser cabling between each identified Telecom Room and the Main Server Room. Contractors shall be responsible for providing and installing all components necessary to complete this scope of work, this includes but is not limited to all, termination hardware, connector panel housings, cable supports and all cable management hardware.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in ANSI/TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Submit manufacturers' product data sheets for all material and equipment products proposed in bid. Only specified or accepted manufacturers or suppliers shall appear in the product data submittal.
   2. Where substitutions or alternates are requested for any specified manufacturer or product, contractors shall submit complete documentation for the proposed product, including complete product data/catalog sheets, performance/engineering reports and any additional information that may be pertinent to the approval of this product.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics including the following:
      a. Cross-connects.
      b. Patch panels.
      c. Patch cords.
   5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
   6. Pathway (i.e. J-hook/or tray) layouts, showing route to scale, with relationship between the pathway and any adjacent structural, electrical, and mechanical elements. Include the following:
      a. Vertical and horizontal offsets and transitions.
      b. Clearances for access above and to side of cable trays.
      c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

7. Shop drawings shall be submitted (10) days prior to start of work and prior to ordering any material. Shop drawings shall consist of (1) set of reproducible drawings and (3) copies of all drawings, diagrams and/or manufacturer data in accordance with the contract documentation.
8. As-built documentation shall be provided at the completion of installation. As-built documentation shall include all floor plan views, elevations drawings, cable termination and cross connect schedules. Drawing sets shall consist of (1) reproducible set (velum and electronic) and (3) hard copies. All Schedules shall include (1) hard copy set and (1) electronic copies.
9. Contractors shall note that any electronic media sets that are to be turned in at the completion of the project should be coordinated with the end-user to ensure proper formatting and/or software compatibility.

C. Qualification Data: For layout technician, installation supervisor, and Project manager.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

G. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff is recommended.
1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by a certified designer.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

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. Telecommunications Pathways and Spaces: Comply with ANSI/TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-C.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
1. Test optical fiber cable to determine the continuity of the strands end to end. Use optical fiber flashlight or optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, etc.,

including the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

B. Delivery and Storage

1. Contractor shall be responsible for the coordination and receipt of any job related material being shipped to the site and also for ensuring the proper storage and safe guard of this material. Coordination of delivery shall include direct communications with the General Contractor, the end-user/facilities group and/or building owner (as necessary) to ensure proper scheduling and delivery requirements.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.

1.12 WARRANTY

A. Cabling Contractor shall have the ability to extend to end-user a minimum warranty period of 20 years for the system(s) they intend to install. This warranty shall certify that the installation will be free from defects in performance and workmanship, as well as meet or exceed all ANSI/TIA/EIA performance requirements. Contractor will be required to submit all pre-project and post project documentation including test documentation and registration forms necessary for system coverage under this program.

B. System coverage shall but is not limited to the following components.

1. Cabling components.
2. Connecting Hardware.
3. Connectors.
4. Jacks/Outlets.

PART 2 - PRODUCTS

2.1 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berk-Tek: 25-Pair Category 3 Plenum-Rated
      a. Gray (10032111)
   2. Berk-Tek: 100-Pair Category 3 Plenum-Rated
      a. Gray (10032113)

B. Description: 100-ohm UTP:
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with ANSI/TIA/EIA-568-B.1 for performance specifications.
   3. Comply with ANSI/TIA/EIA-568-B.2, Category 3.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following type (or equivalent).
   5. Type requirements in subparagraphs below are minimum requirements and may be revised to suit Project. Retain options if "permitted substitutions," as defined in NFPA 70, are appropriate for this Project.
   6. Communications Plenum Cable: Type CMP

2.2 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ortronics:
      a. Flat 48-Port CAT6A Patch Panel (OR-PHD6AU48)

B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

2.3 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Commscope:
      a. Quad-shielded Series-11 Plenum-Rated Coaxial Cable: 2287K

B. Description:
   1. 3GHz RG11 75-Ohm
   2. 14 AWG copper-clad steel wire

C. Jacket:
   1. Jacket Color: Cream.
   2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.4 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Corning:

a. 12-Strand MIC Tight-Buffered, Dielectric Armored Plenum-Rated Single-mode Cable: 012E88-33131-D3

B. Description: Single-mode, 9/125-micrometer (OS2), dielectric/nonconductive armored, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with ANSI/TIA/EIA-568-B.3 for performance specifications.
3. Comply with ANSI/TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled as complying with UL 444, UL 1651, and NFPA 70 for the following types (or equivalent).
5. Plenum Rated, Nonconductive: Type NFPA 262.
6. Maximum Attenuation: 0.65 dB/km at 1310 nm; 0.65 dB/km at 1383 nm; 0.5 dB/km at 1550 nm

C. Jacket:
1. Jacket Color: Yellow
2. Cable cordage jacket, fiber, unit, and group color shall be according to ANSI/TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.5 OPTICAL FIBER CABLE TERMINATION HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Corning:
a. 1U Rack-mount Fiber Enclosure (CCH-01U)
b. 2U Rack-mount Fiber Enclosure (CCH-02U)
c. SC Single-mode Connector Panel (CCH-CP12-59)
d. SC Single-mode Connector (900-200-41)

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths. Exact length & quantity to be field coordinated with client.

D. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 db.

2.6 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-B.

2.7 IDENTIFICATION PRODUCTS

A. Comply with ANSI/TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to ANSI/TIA/EIA-568-B.1.

C. Factory test UTP cables according to ANSI/TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to ANSI/TIA/EIA-526-14-A and ANSI/TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and ANSI/TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with ANSI/TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:
1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches (76 mm)] above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
6. Contracts shall provide any additional transitional fittings to properly route and manage all cabling to its final termination point.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
1. Comply with ANSI/TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install an 8-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
1. Comply with ANSI/TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/4 inch (6 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with ANSI/TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (5' mm) on centers.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:
1. Comply with BICSI TDMM and ANSI/TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping. "Comply with ANSI/TIA/EIA-569-A, Annex A, "Firestopping."
B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-B.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with ANSI/TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   1. Administration Class: 3.
   2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with ANSI/TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.

D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and Telecom Room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications rooms, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

G. Cable and Wire Identification:
   1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 25 feet (4.5 m).
   4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
1. For cables, use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with ANSI/TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical Fiber Cable Tests:
a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:
1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to ANSI/TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in ANSI/TIA/EIA-568-B.1.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pathways
   2. UTP cabling
   3. Cable connecting hardware, patch panels, and cross-connects
   4. Telecommunications outlet/connectors
   5. Cabling system identification products
   6. Cable management system

B. Related Sections:
   1. Section 270002 – "Unit Pricing" for voice and data cabling.
   2. Section 270526 – "Grounding & Bonding for Communications Systems"
   3. Section 271300 – "Communications Backbone Cabling"

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

F. EMI: Electromagnetic interference.

G. IDC: Insulation displacement connector.

H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

I. LAN: Local area network.

J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

L. RCDD: Registered Communications Distribution Designer.

M. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

O. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
   1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
   2. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

C. UTP Horizontal Cabling Infrastructure – Contractors shall supply and install to each identified workstation area the quantities of cabling as denoted by the drawing package. Contractors shall note that under this scope of work there will be several different types of workstation outlets based on their exact location and the intended users of this system.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in ANSI/TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Submit manufacturers' product data sheets for all material and equipment products proposed in bid. Only specified or accepted manufacturers or suppliers shall appear in the product data submittal.
   2. Where substitutions or alternates are requested for any specified manufacturer or product, contractor shall submit complete documentation for the proposed product, including complete product data/catalog sheets, performance/engineering reports and any additional information that may be pertinent to the approval of this product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:
   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.
5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
7. Shop drawings shall be submitted (10) days prior to start of work and prior to ordering any material. Shop drawings shall consists of (1) set of reproducible drawings and (3) copies of all drawings, diagrams and/or manufacturer data in accordance with the contract documentation.
8. As-built documentation shall be provided at the completion of installation. As-built documentation shall include all floor plan views, elevations drawings, cable termination and cross connect schedules. Turnover sets shall consist of (1) reproducible set and (3) copies. Schedules shall include (1) hard copy set and (1) electronic.

C. Samples: For workstation outlets, jacks, jack assemblies, and faceplates**,** one for each size and outlet configuration for color selection and evaluation of technical features.

D. Qualification Data: For layout technician, installation supervisor, and Project Manager.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance Data: For splices and connectors to include in maintenance manuals.

H. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

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. Telecommunications Pathways and Spaces: Comply with ANSI/TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-B.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Delivery and Storage
1. Contractor shall be responsible for the coordination and receipt of any job related material being shipped to the site and also for ensuring the proper storage and safe guard of this material. Coordination of delivery shall include direct communications with the General Contractor, the end-user/facilities group and or building owner (as necessary) to ensure proper scheduling and delivery requirements.

1.9 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: One of each type.
4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.11 WARRANTY

A. Cabling Contractor shall have the ability to extend to end-user a minimum warranty period of 20-years for the system(s) they intend to install. This warranty shall certify that the installation will be free from defects in performance and workmanship, as well as meet or exceed all ANIS/TIA/EIA performance requirements. Contractor will be required to submit all pre-project and post project documentation including test documentation and registration forms necessary to system coverage under this program.

B. System coverage shall but is not limited to the following components:
   1. Cabling components
   2. Connecting Hardware
   3. Connectors
   4. Jacks/Outlets

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with ANSI/TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.

2.2 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berk-Tek LANmark 10G2 CAT6A (Color Green for IS)
   2. Berk-Tek LANmark 10G2 CAT6A (Color Orange for CL)

B. Description: 100-ohm, 4-pair UTP:
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with ANSI/TIA/EIA-568-B.1 for performance specifications.
   3. Comply with ANSI/TIA/EIA-568-B.2, Category 6A.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following type (or equivalent).
   5. Type requirements in subparagraphs below are minimum requirements and may be revised to suit Project. Retain options if "permitted substitutions," as defined in NFPA 70, are appropriate for this Project.
   6. Communications Plenum Cable: Type CMP

2.3 UTP CABLE HARDWARE

A. Manufacturers: For specific manufacturers and part numbers, see Section 270002, "Unit Pricing". Subject to compliance with requirements, provide products pricing of manufactures below for leveling:
   1. Patch Panels:
      a. Ortronics 48-Port Patch Panel - 568A Pinning (OR-PHD6AU48)

B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors 568A pinning at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

E. Patch Cords: Factory-made, four-pair cables. Exact length and quantity to be field coordinated with Client.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.
   3. Patch cords shall be manufactured by the same company as the cable plant.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products pricing of manufactures below:

   1. Work Area Outlets – Color to be coordinate on site with the architect

      a. Ortronics 1-Gang Faceplate (OR-40300158)
      b. 1-Port Cat6 Faceplate Insert (OR-S21600)
      c. 2-Port Cat6 Faceplate Insert (OR-S22600)
      d. Blank Faceplate Insert (OR-40300164)
      e. Blue Data Icon (OR-40326200)
      f. Green Data Icon (OR-40325200)
      g. White Data Icon (OR-40309200)
      h. Orange Data Icon (OR-40323200) – for Clinical Engineering Outlets Only
      i. 1-Port F-Connector (F/F) Faceplate Insert (OR-60900017-99)
      j. Ortronics Clarity 6A TracJack (OR-TJ6A)

B. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with ANSI/TIA/EIA-568-B.1.

C. All jacks shall be color coded for identification purposes. Refer to drawing package for colors and outlet configuration and/other application requirement. Verify colors with owner before purchase;

D. Work Area Outlets: connector assemblies mounted in single faceplate, as denoted on drawings.
   1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
   2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
   3. Legend: Machine printed, in the field, using adhesive-tape label.
   4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-C.

2.6 IDENTIFICATION PRODUCTS

A. Comply with ANSI/TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to ANSI/TIA/EIA-568-B.1.

C. Factory test UTP cables according to ANSI/TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and ANSI/TIA/EIA-569-A-7.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with ANSI/TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:
   1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
   2. Install cable trays to route cables if conduits cannot be located in these positions.
   3. Secure conduits to backboard when entering room from overhead.
   4. Extend conduits 3 inches (76 mm)] above finished floor.
   5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Comply with ANSI/TIA/EIA-568-B.1.
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Install 110-style IDC termination hardware unless otherwise indicated.
   4. MUTOA shall not be used as a cross-connect point.
   5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
      a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
      b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
   6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
   7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
   9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   12. In the communications equipment room, install a 10-foot (3-m-) long service loop on each end of cable.

13. Pulling Cable: Comply with industry standards. Monitor cable pull tensions.

C. UTP Cable Installation:
   1. Comply with ANSI/TIA/EIA-568-B.2.
   2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (5') on centers.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:
   1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
   2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
   3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
   4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
      b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
      c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
   5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
   6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with ANSI/TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to Section 26, "Grounding, Bonding, and Electrical Protection".

B. Comply with ANSI-J-STD-607-B.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with ANSI/TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   1. Administration Class: 3.
   2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with ANSI/TIA/EIA-606-A for Class 3 level of administration, including optional identification requirements of this standard.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:
   1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 25 feet (4.5 m).
   4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
      a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
      b. Label each unit and field within distribution racks and frames.
   5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
   6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in ANSI/TIA/EIA-606-A.
   1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with ANIS/TIA/EIA-568-B.1.
   2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
   3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
      a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:
   a. Test for each telecommunications outlet/connector. Contractor shall test 100% of the horizontal cabling infrastructure in accordance with the requirements specified under ANSI/TIA/EIA-568-B.1 and TIA/EIA-568-B.2 as well as all the selected manufacturers certification and warranty program, including but not limited to the following tests:
      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
7. Optical Fiber Cable Tests:
   a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:
      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to ANSI/TIA/EIA-526-14-A, Method B, One Reference Jumper.
      2) Attenuation test results for backbone links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in ANSI/TIA/EIA-568-B.1.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software if applicable and/or deemed necessary by the Owner or their agent.

END OF SECTION

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SECTION 27 40 00

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

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

B. PUBLIC ADDRESS SYSTEM
   1. This section of the specification defines the functional details of the public address system to be furnished and installed in the MMC new space.

C. SYSTEM FUNCTIONAL REQUIREMENTS
   1. The system design consists of a two-zone paging system: Operating Rooms (ORs) are one zone and all other areas are the second zone. All source and amplification equipment will be installed in a 2-post equipment rack in the Data Room. The equipment rack shall be furnished and installed by the IT contractor. A dedicated telephone number will be selected for paging purposes. The Phone system will require a security code to forward the call to the paging system controller. The Phone system is Owner Furnished. The system can be set to limit the duration of the message being transmitted. Refer to drawings for quantities and locations. The functional requirements are as follows:
      a. Audio System:
         1) Telephone interface module.
         2) System central processing module.
         3) Zone paging module.
         4) 120V AC/12V DC power supply to provide low voltage power to the zone paging module.
         5) Provide a rack mounting kit for the telephone interface module, central processing module and the zone paging modules.
         6) Provide a paging mixer with microphone input modules, which will combine and route the two microphone audio inputs to the paging system telephone interface module.
         7) Provide a rack mounting kit for the paging mixer.
         8) Provide RJ11 modular jack boxes and six conductor modular cable jumpers to route the microphone audio from the paging mixer to the telephone interface module. Quantities as required.
         9) 100 Watt paging amplifiers with rack mounting kits. These amplifiers will be rack mounted on plywood wallfield. Quantities as required.
         10) 35 Watt capacity, speaker zone attenuators with two (2) gang, surface mountable junction box enclosures. The attenuator junction box enclosures need to be a minimum three inches in depth to adequately house the attenuator controls. These attenuators and enclosures will be mounted adjacent to the equipment rack.

11) 10 Watt capacity, speaker zone attenuator. These attenuators will be wall mounted in Conference Rooms.
12) Audio distribution amplifier. For installations requiring multiple paging amplifiers tied together from a common paging input to control impedance and stabilize output levels.
13) 8” Diameter, ceiling speaker assemblies. These assemblies consist of a speaker, transformer, enclosure, tile-bridge and grille baffle. Speaker assemblies will be recess mounted in hung ceiling areas. Refer to electrical nurse call plans (E07-02A through E07-02D) for exact speaker placement.
14) Provide all 2-conductor, 16 gauge, shielded plenum-rated cables, connectors, etc. required to complete a full working system.

b. Miscellaneous
1) 19" wide, 84” high 2-post equipment rack (by others).
2) Rack-mounted UPS dedicated for PA equipment.
3) Provide all cables, connectors, etc. required to complete a full working system.

D. SYSTEM INTERCONNECTIONS
1. The functional interconnections of the public address system shall be as detailed on the specified drawings.
2. The audio contractor shall provide all required interconnection cable, all connectors, plates, etc. to facilitate the installation of a fully functional public address system, as detailed within these specifications and drawings.

E. RELATED WORK SPECIFIED ELSEWHERE
1. The following equipment and systems are NOT provided under the terms of this specification and/or contract:
a. Power outlets.
b. All wall junction boxes, conduit and pull boxes.

1.2 INSTRUCTIONS TO BIDDERS

A. QUALIFICATION OF BIDDERS
1. The Bidder shall be a firm with at least five (5) years’ experience in the fabrication, assembly and installation of public address systems of similar complexity, magnitude and quality as specified for the subject project, and shall submit documentation to this effect along with submission of the bid return.

1.3 DEFINITION OF TERMS

A. The term "Owner" shall refer to MMC.

B. The Term “Architect” shall refer to Perkins+Will

C. The term "Consultant" shall refer to AKF Group, LLC.

D. The term "Bidder" shall refer to any firm submitting a bid in response to these issued specifications.

E. The term "Contractor" shall refer to the Systems Contractor who has been awarded the contract for the subject project and who has responsibility for performance of the work specified herein.

F. The term "NIC" shall refer to material(s) and work, which is Not in Contract (not included in this specification) and for which the Contractor is NOT responsible except as otherwise noted and/or detailed herein.

G. The term "OFE" shall refer to Owner Furnished Equipment, which will be provided by the owner to the Contractor. The Contractor shall be responsible for collecting and/or removing such equipment from the owners premises (the equipment's present location) and installing or re-installing the equipment at the audiovisual system site in good functional order as detailed herein.

H. The term "shall" is mandatory; the term "will" is informative; the term "should" is advisory; and the term "provide" means to furnish and install.

1.4 INFORMATION TO BE SUBMITTED WITH THE BID RETURN

A. Equipment Costs
1. The bid return (response) shall include a detailed listing of all equipment to be supplied. Each equipment component shall be individually priced. Equipment costs shall reflect all required and/or requested modifications and/or accessories. Any and all substitutions for specified equipment shall be listed and individually priced on separate pages.

B. Non-Equipment Costs
1. Non-equipment costs shall be detailed for each of the following categories:
a. Engineering: Including all required designs, drawings, run-sheets, instruction manuals, etc.
b. Pre-installation/Installation: Including all on-site installation and wiring. Coordination and supervision, testing, system check-outs, Owner training, etc. to be performed on or off the Owner's premises.
c. General and Administrative: To include all G & A expenses, shipping, insurance and guarantees.

C. Warranty Statement
1. In order to maintain certain manufacturer's warranties, system equipment must be installed, aligned and serviced by those installers recognized and authorized by said manufacturers to be capable of performing such duties. If a certain installer is NOT so authorized by a particular manufacturer, it is solely their responsibility to make such arrangements to come into such compliance and they shall bear all costs and consequences thereof.
2. The bidder shall include a statement of warranty on the entire system to be installed and on the individual equipment components of the system. The system warranty shall be for a minimum of 365 days from the date of system acceptance by the Consultant and/or the Owner's representative. This warranty shall obligate the Contractor to provide all equipment, materials, and labor for repair, at no charge to the Owner during the warranty period, in the event of system or equipment malfunction
3. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of system acceptance. In the case of Contractor-modified equipment, the manufacturer's warranty is normally voided. In such cases, the Contractor shall provide the Owner with a warranty equivalent to that of the original manufacturer.

D. Service Contract
1. The Bidder shall offer a separate annual service contract, covering all installed systems. This service contract shall cover a minimum of three (3) visits per

year, at regular intervals, in order to perform operational checks of the system and equipment as recommended by respective manufacturers. The service contract shall commence immediately after expiration of the warranty period. A "per-component" price for the service contract shall be submitted with the bid.

2. The Bidder shall also submit separate pricing for other, non-routine, emergency, "on-call" service visits and an "in-shop" hourly rate for repair and maintenance work.
3. Service and service contract related costs shall NOT be commingled with the costs for the system's base-bid.

E. Schedule of Implementation
1. The bidder shall submit a scheduling plan with the bid return, indicating the various pertinent "terminal" dates after the contract award for completion of design, pre-installation work completion, on-site installation, and testing/acceptance.

F. Alternate Equipment
1. All bids shall be submitted on the basis of the recommended equipment listed in the part 2, products section of the specification.
2. The Bidder may propose alternate equipment. However, all such proposals shall be submitted separately and will be identified as "alternate(s)" with equipment costs shown as separate and apart from the costs of the equipment "as specified."
3. Proposals for alternate equipment will receive careful and equitable consideration if differences do not result in a departure from the overall intent of the system design and operation, and are demonstrated to be in the best interests of the Owner.
4. All such proposals for alternate equipment shall be accompanied by complete technical information and specifications, and "cut-sheets" for the equipment so proposed. The Bidder shall identify any and all substantive differences between the "alternate" and "specified" equipment.

G. Exceptions and Proposed Modifications
1. Should the Bidder wish to propose recommendations which will enhance the performance of the system, or reduce costs without loss of performance, such comments shall be made in the bid submissions. All suggestions which are of value to the Owner, shall be taken into consideration in the evaluation of bid returns. All such proposals shall be made as "alternative(s)", with the appropriate cost modifications clearly shown separate and apart from the costs of the system "as specified."
2. Any and all exceptions to specifications and related drawings must be made with the bid submission. In the absence of exceptions, these specifications and related drawings shall be binding in letter and intent upon the successful Bidder. It will be further assumed that the Bidder has examined all designs and specifications in detail and is prepared to accept full responsibility for the performance of the complete system installation as designed and specified

H. Sub-Contract Information
1. If the Bidder proposes to sub-contract any portion of the system installation work, as provided for under Section 1.7 which follows, any such sub-contractors shall be clearly identified and their responsibilities and qualifications detailed in the Bidder's bid submission. Any and all work

performed by a sub-contractor shall be considered fully as part of the primary Bidder's contract and responsibility.

I. Visit to Site
   1. All Bidders may request to make a "Pre-Bidder's" site inspection before submission of bids. The date of the site visit shall be included in the bid return. The Bidder shall arrange for the site-visit with the Owner's representatives.

1.5 SPECIFICATION DRAWINGS

A. All drawings referred to herein are furnished with and become an integral part of this specification. These drawings and specifications shall remain the property of the Owner and shall be returned to the Owner by all unsuccessful Bidders, within ten (10) days after formal notification of contract award.

1.6 SPECIFICATION INFORMATION REQUESTS

A. Any requests for clarification, substitution, or changes to these specifications and/or drawings shall be directed to the engineer. These information requests will be entertained no later than two days before the bid closing date.

1.7 SUB-CONTRACT

A. If the Bidder proposes to sub-contract the installation and/or wiring, or any portion of this work, the Bidder shall provide direct supervision of any and all sub-contracted work.

B. As a result of the complexity and criticality of the specified public address system, the supervision of sub-contracted work shall not be intermittent, but MUST be continuous for the entire duration of such installation.

C. If it is the intent of the Bidder to "team" with one or more additional contractors, then this must be clearly stated and so identified the Bidder's bid return. The Contractor (Bidder) who is returning the bid shall be considered as the "prime" with respect to these circumstances, and will assume and accept full responsibility for the performance of all members of the "team," including themselves and all other sub-contractors and/or sub/sub-contractors engaged in the performance of the contract.

1.8 INVESTIGATION OF CONTRACTUAL AND/OR SCHEDULING QUESTIONS

A. It shall be the sole responsibility of the Bidder to investigate any and all potential contract, union-related and scheduling questions and issues, and to guarantee compliance with all requirements and regulations, which shall be in effect on the job site. Any potential problems in this regard should be clearly identified and addressed in the bid return.

1.9 AWARD OF CONTRACT

A. A single award of contract will be made for all systems as detailed in this specification. Quoted prices shall remain firm for a period of sixty (60) days.

B. The Owner reserves the right to reject any or all bids for any reason.

PART 2 - PRODUCTS

2.1 Paging System Telephone Interface Module, Rack Mounted.

A. Manufacturer: Bogen
1. Model number: PCMTIM
2. Include pricing for one (1) spare unit.

2.2 Paging System Central Processing Module, Rack Mounted.

A. Manufacturer: Bogen
1. Model number: PCMCPU
2. Include pricing for one (1) spare unit.

2.3 Paging System Zone Paging Module, Rack Mounted.

A. Manufacturer: Bogen
1. Model number: PCMZPM
2. Include pricing for one (1) spare unit.

2.4 Paging System Power Supply.

A. Manufacturer: Bogen
1. Model number: PCMPS2
2. Include pricing for one (1) spare unit.

2.5 Rack Mount Kit for TIM, CPU and ZPM's

A. Manufacturer: Bogen
1. Model number: RPK88

2.6 Paging Mixer, Rack Mounted.

A. Manufacturer: Bogen

1. Model number: VMIX
2. Include pricing for one (1) spare unit.

2.7 Microphone Input Module for Paging Mixer

A. Manufacturer: Bogen
1. Model number: MIC2S
2. Include pricing for one (1) spare unit.

2.8 Rack Mounting Kit for Paging Mixer

A. Manufacturer: Bogen
1. Model number: RPK87
2. Include pricing for one (1) spare unit.

2.9 Microphone with Push-to-Talk Switch

A. Manufacturer: Bogen

1. Model number: DDU-250
2. Include pricing for one (1) spare unit.

2.10 Paging Amplifier, 100 Watt, Wall Mounted

A. Manufacturer: Bogen
1. Part number: TPU100B
2. Include pricing for one (1) spare unit.

2.11 Rack Mounting Kit for Paging Amplifier

A. Manufacturer: Bogen
1. Part number: RPK82

2.12 Speaker Zone Attenuator, 35 Watt Capacity, Wall Mounted

A. Manufacturer: Bogen
1. Model number: AT35A

2.13 Speaker Zone Attenuator, 10 Watt Capacity, Wall Mounted

A. Manufacturer: Bogen
1. Model number: AT10A

2.14 8” Diameter, Ceiling Speaker Assembly with Speaker, Transformer, Enclosure, Tile Bridge and Grille

A. Manufacturer: Bogen
1. Model number: S810T725PG8WVK

2.15 8-Channel Audio Distribution Amplifier

A. Manufacturer: Radio Design Labs
1. Model number: RU-ADA4D
2. Include pricing for one (1) spare unit.

2.16 UPS, Rack Mounted, 1500VA w/ NEMA 5-15P input

A. Manufacturer: APC
1. Part number: SMT1500RM2U

2.17 Miscellaneous Hardware, Cable, Connectors, RJ11 Module Boxes, Six Conductor Module Cable Jumpers, etc.

A. Manufacturer: PA Contractor
1. Part number: Custom

2.18 Speaker Cable Loop Terminal Block. Quantity as required.

A. Manufacturer: GE
1. Part number: CR151B26AF

2.19 2-Conductor, Plenum-Rated Audio Cable. 16-Gauge, Shielded.

A. Manufacturer: West Penn
   1. Part number: 25294B or approved equal

PART 3 - EXECUTION

3.1 CONTRACTOR'S GENERAL RESPONSIBILITIES

A. The Contractor shall be responsible for delivering a turnkey paging system to the Owner.

B. The Contractor shall furnish all equipment and materials, whether specifically mentioned within this document or not, to insure provision of a complete and fully functional system in line with the requirements of this specification. NIC and OFE equipment and materials are exempted from this requirement.

C. The Contractor shall generate all shop drawings and necessary information required for the complete installation of the audio system. The Contractor shall also provide (or sub-contract for) on-site installation and wiring, and shall provide on-going and thorough supervision and coordination of all work performed during the implementation phase.

D. The Contractor shall be responsible for initial adjustment of the public address system as described within this document and shall provide all test and operational equipment required for the system check-out and acceptance testing. The Contractor shall provide hands-on, on-site training in the operations and maintenance of the audio system for those personnel as designated by the Owner.

3.2 NOT IN CONTRACT (NIC)

A. Certain equipment and/or materials will be provided and installed by others. Unless otherwise indicated in these specifications, or on the related drawings, this equipment and material shall include the following:
   1. All conduit(s), wireways, connection boxes, pull-boxes, junction boxes and outlet boxes permanently installed in walls, floors and ceilings.
   2. All room lighting fixtures, dimmers, power receptacles, outlets, and interconnect wiring for these circuits.
   3. All electrical breaker panels required to power the paging system equipment.
   4. All structural work, wall openings, platforms, railings, stairs, fire prevention and safety devices, rough and finished trim, painting and patching, drapes, carpets, floor coverings, computer floors, glazing,
   5. Acoustical treatments and heating, ventilation, and air conditioning systems.
   6. Moveable furniture, desks, and chairs.

3.3 QUALITY OF MATERIALS AND EQUIPMENT

A. All equipment and materials provided by the contractor shall be new and shall meet or exceed the latest published manufacturer's specifications in all respects.

B. The Contractor shall supply the latest model of each piece of specified equipment available at the time of bidding.

3.4 CONTRACTOR'S DOCUMENTATION

A. Prior to system fabrication, the Contractor shall submit (to the Consultant), for approval, any and all custom designs pertaining to the audio system. Drawing submittals shall be reproducible media preferably in machine-readable form. These designs include, but are not limited to, the following:
   1. Full system construction designs and point-to-point wiring schematic drawings, including all component values, and clearly showing complete letter and number identifications for all wires and cables as well as all jacks, terminals and connectors.
   2. All panels, plates and designation strips, including all details relevant to terminology, engraving, finish and color.
   3. Any and all custom designed support bases and shelves.
   4. Schematic drawings of all custom components, assemblies and circuitry.
   5. Any and all unusual equipment modifications.
   6. Run-sheets or field wiring details.
   7. All equipment components, whether stock manufacture or custom built, shall be supported by complete and detailed schematic drawings and replacement parts. NO "black boxes" or otherwise unidentified or unidentifiable components shall be acceptable under the terms of this specification.

B. At completion of the full system installation, the Contractor shall provide two (2) copies each of the following:
   1. Equipment manufacturer's operation manuals for each piece of installed Audio equipment.
   2. "As Built" drawings for every item indicated in Section 3.4-1.
   3. System functional block drawing identical to the AKF specification drawing with addition of all input and output circuit cable and terminal block numbers as well as all jack field circuit I.D. designations. A copy of this drawing shall be framed in protective plastic and mounted near the audio system equipment rack.
   4. One System Operations and Maintenance Manual. This manual shall be produced by the Contractor specifically for the systems installed and outlined in this specification.
      a. The "Operations" section shall describe all standard and typical procedures required to activate the system and each of its parts to provide for full system functionality as outlined in the General section of the specification.
      b. Readers of these manuals shall be assumed to be technically competent, but unfamiliar with the particular facility and installation. It is expected that this manual will require a minimum of five (5) pages.
      c. The "Maintenance" section shall provide a recommended maintenance schedule with reference to applicable pages in the manufacturer's maintenance manuals. When adequate information is not provided by the manufacturer, the Contractor shall directly provide the information necessary for proper maintenance.
      d. NOTE: One copy of all above documentation will be retained by the Owner. One additional copy shall be delivered to the Consultant prior to System Acceptance Testing.
      e. This information MUST also be provided on CD in an easily readable format (e.g. Microsoft Word, Excel, and Adobe Acrobat). The CD shall be accessible to all computers running the Windows operating system.

3.5 SUB CONTRACT

A. No sub-contracting will be allowed in the case of the Contractor's responsibilities (as defined within these specifications), unless specifically identified in the original bid submission and approved by the Consultant and Owner.

B. The Contractor shall have sole responsibility for the satisfactory implementation and delivery of the audio system, even though the Contractor may have sub-contracted some portion of the installation or had specific manufactures install their own equipment.

3.6 COOPERATION WITH OTHER TRADES

A. It shall be the Contractor's responsibility to cooperate, at all times and to the fullest extent, with any and all other trades performing work on premises in order to avoid lost-time, work stoppages, interference and other inefficiencies.

3.7 EQUIPMENT DELIVERY AND STORAGE

A. Any and all equipment delivered or received prior to system installation shall be stored by the Contractor at their place of business. Any costs of shipping, or of any unusual storage requirements shall be borne by the Contractor. The Contractor shall inform the Owner no later than seven (7) days in advance of delivery to the installation site. It shall be the responsibility of the Contractor to make all appropriate arrangements with authorized personnel at the work site for the proper acceptance, handling, protection and storage of equipment so delivered.

3.8 CLEANUP AND REPAIR

A. Upon completion of all work, the Contractor shall remove any and all refuse and rubbish from and about the Owner premises, and shall leave all areas and equipment clean and in a fully operational state.

B. The Contractor shall be responsible for the repair of any damage caused to the premises by installation activities, at no cost or hardship to the Owner.

3.9 OWNER TRAINING

A. The Contractor shall provide relevant on-the-job training (by a suitably qualified instructor) for those personnel designated by the Owner, in order to instruct them in the operation of the installed audio system. In the event that the Contractor does not have suitably qualified instructors on staff for specific highly sophisticated equipment components and/or systems, a manufacturer's representative for such equipment will be provided by the Contractor at no additional cost to the Owner. All such training shall take place after the system is fully operational, but prior to acceptance testing. There shall be a minimum of 3 hours of training provided for systems covered under this specification.

3.10 PUBLICATION

A. No information relative to the job covered under this specification may be released for publication without prior written consent and approval from the Owner and the Consultant.

3.11 INSURANCE

A. Prior to commencing work, the Contractor shall procure and maintain, for the full duration of the system installation, such comprehensive liability and property damage insurance as shall protect both themselves and the Owner from claims for bodily injury, including accidental death, and for any claims of property damage which may arise from the operations under this contract and specification.

3.12 INSTALLATION PRACTICES

A. General
   1. Installation shall be understood to include the delivery, unloading, positioning in place, securing to walls, floors, ceilings, counters or other structures as required, interconnect wiring of all system components, equipment alignment/adjustment and all other work whether or not expressly called for in this document which is necessary to result in complete and fully operational system.
   2. All installation practices shall be in full accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with all applicable standards, requirements and recommendations of National, State and Local authorities having jurisdiction over these and other relevant matters.
   3. If in the opinion of the Contractor, an installation practice is desired or required which runs contrary to these specifications and drawings, written request for modification shall be made to the Consultant. Any and all such modifications shall not take place without written approval.
   4. During the system installation, and up to the date of final acceptance, the Contractor shall be under obligation to protect his finished and unfinished work against loss and/or damage. In the event of loss or damage, he shall replace or repair any and all work at no cost to the Owner.

B. Physical Installation
   1. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise.
   2. All fastenings and supports shall be adequate to support their loads with a safety factor of at least three (3). All boxes, equipment, racks, stands, etc., shall be secured, plumb and square.
   3. In the installation of equipment and cabling, full consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.

C. Cable Installation
   1. All wire bundles are to be neat and combed free of cable crossover. Using J-hook to support cable bundles at every 5 feet interval.
   2. All cables, regardless of length, shall be clearly marked with a permanent, wrap-around number or letter cable marker at both ends. There shall be no unmarked cables at any place or position in the paging system. Marking codes used on cables shall correspond to codes shown on drawings and/or run-sheets.
   3. No splices shall be permitted in any pull-boxes without prior permission from the Consultant.
   4. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.

D. Connection Plate Receptacles

1. Audio (microphone or line level) - XLR type.

E. Grounding Procedures
1. In order to eliminate or minimize potential problems resulting from improper grounding, and to achieve absolute minimum signal-to-noise ratios, the following grounding procedures shall be observed:
   a. System Grounds
      1) A single, primary "system ground" shall be established for the system. All individual grounding conductors shall connect to this "system ground". The system ground shall be provided in the audio equipment area and shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors.
      2) A copper conductor having a maximum of 0.1 Ohms total resistance shall connect the primary system ground to the nearest metallic electrical conduit of at least 2" in diameter. The paging Contractor shall be responsible for determining whether or not the metallic conduit is properly electrically bonded to the building ground system.
      3) If a secondary system grounding conductors is provided, this grounding conductor shall have a maximum of 0.1 Ohms of total resistance.
2. Under no condition shall the AC neutral conductor, in either the power panel or in any receptacle outlet, be used as a system ground.
   a. Audio Cable Shields:
      1) All audio cable shields shall be grounded at one (1) point only. NO exceptions shall be made. For ungrounded portable equipment, such as microphones, the shield should be connected at both ends but grounded at a single end only.
   b. General:
      1) Because of the great number of variations in grounding systems, it shall be the responsibility of the Contractor to follow good engineering practice (as outlined above) and to deviate from these practices ONLY when deemed necessary to minimize "crosstalk" and to maximize signal-to-noise ratios in the audio system.

3.13 PERFOMANCE STANDARDS

A. Unless restricted or prohibited under the terms of the published specifications of a particular equipment manufacturer, or, unless otherwise required under the terms of this Detailed Specification, the following performance standards shall be met in each case and for all systems:
1. AUDIO:
   a. S/N (including crosstalk and hum) 65dB minimum.
   b. Total Harmonic Distortion … 1% maximum from 30 Hz to 15,000 Hz.
   c. Frequency Response … within plus or minus 1.0 dB, 30Hz to 15,000 Hz.

B. PERFORMANCE TEST SIGNAL PATHS:
1. The signal paths for the above defined Performance Standards shall be as follows:
2. Audio:

a. From all source inputs (for microphones, etc.) through all audio equipment, etc., to all signal destinations.
b. Delineation of the above defined signal paths shall NOT exempt the Contractor from the responsibility of checking all paths and outlets for appropriate compliance with the Performance Standards.
c. During ALL Performance Testing, all equipment shall be operated under standard conditions as recommended by the manufacturer.

3.14 CONTRACTOR SYSTEM CHECK-OUT

A. Before Acceptance Tests are scheduled, the Contractor shall perform his own system check-out. He shall furnish all required test equipment and shall perform all work that is necessary to determine and/or modify/correct performance of the system in order to meet the requirements of this Specification.

3.15 SYSTEM ACCEPTANCE TESTS

A. System Acceptance Testing shall not be performed until the Contractor's own System Checkout has been completed and test results have been recorded and reviewed. The System Acceptance Tests will be supervised by the Consultant representative and will consist of the following:
1. A physical inventory will be taken of all equipment on site and will be compared to equipment lists in the contract documents.
2. The operation of all system equipment shall be demonstrated by the Contractor.
3. Both subjective and objective tests will be required by the Consultant to determine compliance with the specifications. The Contractor shall be responsible for providing test equipment for these tests.
4. All final, "as-built" drawings, run sheets, manuals, and other required documents, as detailed in Section 3.4, shall be on hand. Two complete sets of these documents shall be delivered to the Owner at this time. (One complete set shall have been delivered to the Consultant prior to scheduling of Acceptance Tests).
5. In the event further adjustment is required, or that defective equipment is discovered which must be repaired or replaced, further testing may be either suspended or continued at the option of the Consultant.
6. Any charges for additional Consultant time required to oversee system tests due to improper system installation or previously failed system tests shall be the responsibility of, and charged directly to the Contractor.

END OF SECTION

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SECTION 28 10 00

SECURITY SYSTEM

PART 1- GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the electronic Access Control, Intrusion detection and CCTV Video system and Video Management System.

B. Card holder information/enrollment existing.

C. Related Sections include the following:
   1. Division 16 Section "Raceways and Boxes."
   2. Division 16 Electrical Sections

D. The work covered by this specification includes the construction described, including all labor necessary to perform and complete such construction; all materials and equipment incorporated or to be incorporated in such construction; and all services, facilities, tools and equipment necessary or used to perform and complete such construction.

E. Provide the following:
   1. Furnish, install, terminate, test and document new electronic access control system, including proximity card readers, door contacts, request to exit devices, control panels, cabling, software and interface with Owner's networks/central station and integrated with local fire alarm system. ALL MECHANICAL DOOR HARDWARE IS FURNISHED & INSTALLED BY OTHERS. COORDINATE WITH ARCHITECT.
   2. Furnish, install, terminate, test and document new electronic alarm system, including door and window contacts, PIR motion detectors, duress alarms, tamper switches, aural and visual alarm enunciators, control panels, cabling, software and interface with Owner's networks/central station and local fire alarm system.
   3. Furnish, install, terminate, test and document new CCTV system, including cameras, camera mounts, camera power supplies, digital video recorders, monitors, cabling and all other required components.
   4. Access Control Software House server existing. (C-Cure 800)
   5. CCTV Server/Video management existing (Onssi)
   6. It is the intent of these design/build specifications to procure a complete, workable and programmed Security System, compatible with the Owner's planned and existing systems and ready for the Owner's use. Any item not specifically shown on the drawings or called for in the Specifications, but normally required to conform to the intent, is to be considered as part of the Contract.

7. Any given item of equipment, material or software shall be the product of manufacturers indicated within this specification or approved equal, throughout the facility. Multiple manufacturers of any one item shall not be permitted, unless specifically noted otherwise or approved by the Owner.
8. These Specifications are equipment and performance Specifications. Any discrepancies found between the Specifications and Drawings shall be brought to the attention of the Consultant. Installation and details indicated on the Drawings shall govern if they differ from the Specifications.
9. Bidders are encouraged to proposed alternative solutions that are fully compliant with the Client's requirements
10. Certain terms such as "shall, provide, install, complete, etc." are not used in some parts of these Specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

1.3 SUBMITTALS

A. Submit manufacturers' product data sheets for all material and equipment products proposed in bid. Only specified or accepted manufacturers or suppliers shall appear in the product data submittal.

B. Provide physical samples of products if requested by Consultant.

C. Where substitutions or alternates are requested for any specified manufacturer or product, submit complete documentation for the product proposed, including complete product data and catalog cut sheets, engineering test and performance reports and any other information pertinent to the product.

D. Submit shop drawings for review ten (10) days prior to start of work and prior to ordering of material to consist of one (1) set of reproducible and three (3) sets of prints of drawings, diagrams, and/or manufacturers' data in accordance with the contract documents.

E. At completion of installation, furnish a complete set of as-built documents, including plan view and elevation drawings, device schedules, test and acceptance documentation, equipment manuals and operating instructions.

F. As-built drawings shall consist of one (1) set of reproducible and three (3) sets of prints, and one (1) computer format CD.

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70, "National Electrical Code."

C. Comply with applicable SIA Industry Standards.

D. Codes, Regulations And Standards
1. Comply with the most recently issued requirements, standards, recommendations, rules, and regulations of authorities having jurisdiction over the project.
2. Follow the most restrictive code or recommendations. Where there are ambiguities, refer to the Consultant for interpretation.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide the products called out below and on drawings or approved equal. Where a specific manufacturer has not been called out, provide industry standard products of first quality and fully compatible with the system.

B. All equipment shall be equal to or exceed the applicable minimum requirements of NEC, IEEE, ASME, ANSI and UL.

C. All products and materials shall be new, clean, free of defects or damage and of first quality.

D. Coordinate device quantities, locations, types and finishes with architect.

E. The work covered by this specification includes the construction described, including all labor necessary to perform and complete such construction; all materials, software and equipment incorporated or to be incorporated in such construction; and all services, facilities, tools and equipment necessary or used to perform and complete such construction.

2.2 ACCESS CONTROL SYSTEM (existing)

A. Furnish & Install a PC-based Access Control Management System (ACMS) detailed below, complete with all hardware necessary for a complete and functional system. The system shall have ample capacity to accommodate future growth, integrate with the fire alarm system and shall have an open architecture which allows importing and exporting of data from other applications. The system shall be capable of stand-alone operation. Provide the following components:

1. The SMS shall be an integrated system that utilizes a single, industry-standard relational database management system for the storage and manipulation of related data. The SMS shall include a server with operating system and applications software, operator and administrator terminals with appropriate software, hard copy printers and fixed magnetic storage media. The security devices shall communicate with the field panels via a dedicated cable network. The field panels shall communicate to the server via a Fast Ethernet 10/100, TCP/IP network or a serial (RS-232, RS-485) connection.
2. The SMS shall employ a standard Windows XP™ Professional, Windows 2003 Server, or later graphical user interface (GUI). A mouse and keyboard shall be the primary operator interface with the system. Operator screens shall utilize all standard Windows-style functions such as drop-down menus, context menus, radio buttons, and lists, as appropriate. The interface shall utilize a 'tree structure' similar to Windows Explorer.
3. The ACMS shall be flexible and scalable in architecture, permitting expansion of both capacity and functionality, to be implemented progressively as needed, through software licensing and/or software upgrades.
4. The ACMS shall employ distributed processing technology, allowing the host to function almost entirely as an application/database server. The majority of the real time, day-to-day decisions shall be made locally by intelligent control panels. The control panels shall be the direct field interface for all access control, alarm sensing, and input/output-controlled devices.

5. The ACMS shall manage and automatically download in real-time, all database changes made at all operator workstations, to the control panels that require notification of the specific database changes or updates.
6. The SMS hardware shall be comprised of modular components that connect over standard interfaces to one another. There shall be a Data Gathering Unit storage and processing module (DGU), and once data has been downloaded to the DGU it shall locally make access control decisions. Access granted or denied decisions shall be made in under 0.5 seconds
7. The DGU shall store firmware in non-volatile flash memory to allow for convenient updates through the head-end software application. The DGU shall store the cardholder and configuration database information in battery-backed memory so that loss of primary power will not cause the loss of the database.
8. The DGU shall support configurations that include: 16 card readers, 96 monitored input points, or 32 auxiliary output points.
9. There shall be an intelligent controller option to provide control of 8 readers/doors from a single circuit board (communications, memory, CPU, and reader/door functions integrated) with an available 8-reader/door add-on to provide a 16-door controller from two circuit boards. The 8-door controller shall provide an integrated on-board RS-232 interface, and shall have provisions for modular expandable memory.
10. There shall be an option for hardware made with a lead-free manufacturing process to meet RoHS requirements.
11. Communication Schemes
    a. Hardwired Communications
        1) The field panels shall be located convenient to the access and monitor points that they control, and shall be interconnected in a chain configuration to a serial port of a convenient client PC on the system.
        2) The system shall support a minimum of 31 intelligent field panels (nodes) daisy-chained together such that they communicate back to a single serial communications port at the host.
    b. Bi-Directional Communications
        1) A chain of field panels shall be wired in a loop configuration, by the addition of a cable from the last controller and connecting it into a second port on the PC. When this configuration is installed, should a break in the cable occur, the PC shall be able to communicate with the nodes after the break, via the secondary port.
12. Network Communications
    a. The first field panel in a chain of panels shall have the ability to communicate with its monitoring client PC over the local or wide area network. This shall be achieved by the addition of a network interface option module and provide a cost effective alternative configuration to a direct connection via a client PC's serial port. The network interface shall support both "10 base T" and "100 base TX" (10/100) communications speeds. The network interface shall support encryption utilizing either TwoFish or AES algorithms.
    b. An optional modem and telephone line shall be configured to provide an alternative path for the reporting of alarms. The fallback to dial-up alarms reporting shall be automatic in the event of detecting a network communications failure.

13. Efficient Memory Management
    a. Controllers shall be capable of supporting cardholder populations of at least 200,000, or be configured to a learning mode that allows the cards most frequently used to have their access rights stored locally in the panel's memory.
    b. When a card is presented which is not resident in the local panel, a verification request shall be made to the central database, if the card is valid the details shall be downloaded. If the card memory is full, the card with the oldest transaction date shall be deleted to make space for the card requested. This shall allow automatic management of cardholders, based upon frequent users having "instant" response and infrequent users learned when required.
14. Database Synchronization
    a. To ensure synchronization of the distributed controllers' databases with a region's main database an internal checking process shall be provided within each controller. In the event of corruption of a controller's local database then it shall be able to detect this condition and automatically request the relevant data to be downloaded from its local server. This action shall not require Operator intervention.
    b. The system shall continue to provide access control functionality during this re-synchronization process.
15. Door lock release relays shall be minimally rated for 3 A @ 30 VDC.
16. Readers supporting various technologies shall provide data from card presentations or biometric authentications through a door control unit (DGP) that includes the electrical interface to the reader as well as inputs for door sensors and form C relays for outputs.
17. The DGP shall support Wiegand communications to the reader. In order to provide higher levels of security, the DGP shall support bi-directional, supervised, and encrypted communications to the reader. Door controllers that do not support encryption and supervision of reader communications are not considered equal.
18. The controller shall support a direct serial connection to the Edge Network Video Server (ENVSTM) for alarm transmission.
19. The system shall support an option to store cardholder biometric information (e.g. fingerprint or hand geometry templates) at the panel (as part of the cardholder record). Storage of the template data at the reader shall be unacceptable. An acceptable alternative is to store individual templates on secure smart cards.
20. The SMS hardware shall support all of the following options for supervision of the monitored input points:
    a. 2-state supervision – in which only secured and alarm state are indicated.
    b. 3-state supervision – in which the input state can be secure, alarm or open circuit.
    c. 4-state supervision – supports secure, alarm, short circuit and open circuit states.
    d. 6-state supervision – supports secure, alarm, short or open circuit for the sensor in addition to tamper alarm and tamper short circuit states.
21. High Availability and Disaster Recovery (Provide as alternate)
    a. To provide greater client software availability, software shall be installed so that in the event of a database server failure, client machines will

quickly and without operator intervention, automatically connect to a standby server machine.

b. This configuration shall utilize the industry standard Microsoft clustering solution and allow for an installation with a large number of client machines, the ability to continue to operate without interruption, while the cause of the main server failure is investigated.

c. The SMS product shall be capable of supporting options for 99.99% and 99.999% availability.

22. Bandwidth Utilization
    a. The proposal shall include documented manufacturer's evidence of network bandwidth utilization including plots and supporting data, covering all aspects of normal system operation. Proposal submissions without supporting documentation will not be considered or evaluated.
23. Encryption
    a. Encryption falls into two distinct areas, firstly between clients and their Server, secondly between client and local area network panels (LAN Nodes).
    b. LAN node links shall support Two Fish and AES encryption between the supervising client PC and its LAN Chains.
    c. For client to server connections, the SMS shall support a solution using industry standard network cards, such as the Intel Pro 100s, which support IPSec and 3DES encryption.
    d. Web-based (thin client) SMS clients shall use 128-bit SSL encryption.
24. Required Standard Software Features
    a. The following software features shall be part of the standard product offering without requiring additional purchase or licensing.
    b. The installation of the server and client software shall utilize a "wizard" interface to guide users through the appropriate installation steps.
    c. The SMS shall start up as part of the Operating System. The SMS shall run as a service in the OS, and there shall be no requirement to run an application after the operating system is ready.
    d. The SMS shall support a Graphical User Interface that minimizes training needs for even inexperienced users. The software shall include on line help displays to eliminate operator reference manuals.
25. It shall be possible to select any function, within a given Operators permission, independent of the currently displayed screen. Functions will be accessed via tool bar Icons, which will include help prompts that will appear when the mouse pointer dwells on the selection button. It shall also be possible to link any standard Windows application to a custom toolbar icon.
26. A print screen command icon shall be provided, subject to an individual Operator's permission, for all screens and will allow the currently displayed information and screen presentation to be printed.
27. The system shall support an unrestricted number of time codes. Furthermore, the system shall support a minimum of 10 intervals per time code.
28. The SMS shall support an unrestricted number of time intervals. A time interval is a defined span of time such as "08:00 to 17:00" as "Business Hours". Time intervals shall be permitted to span midnight, such as "20:00 to 05:00" as "Third Shift".
29. The system shall be scalable to a multiple-server implementation where each region (either geographical or logical) has a server capable of making local decisions and configuration changes. The Global head-end server responsible

for managing the entire enterprise including all regional servers shall support a minimum of 999 regional servers.

30. Operator Permissions
    a. System operators shall be associated with a log in Name and Password. A system option will determine whether strong operator passwords will be used. The minimum definition of a strong password shall be a password that contains at least one upper case character, one lower case character, one numeral and one punctuation mark, with a minimum password length of six characters. Additionally the password cannot contain any full word of the operator's username.
    b. The option to use a Secure Biometric or Smart card for system logon shall be provided. When used, this option will force the operator to present their Name, Password and Biometric or Smart card.
    c. Operators shall be assigned to permission profiles. This will determine the functions that will be available to that operator when logged-on to the system. Each operator is required to only see the functions for which s/he has access. The system shall support an option to hide Personal Identification Numbers of cardholders when an operator is viewing a record.
    d. Card record data entry shall be divided into operator permission areas, allowing separate permission categories to be assigned for the viewing of personal data, ID badge printing and access right management.
    e. The SMS shall support an unrestricted number of operators and operator permission profiles.
    f. For all operators, a means of re-arranging their Icon tool bar shall be provided to allow the most frequently used Icons to be repositioned by the operator.
    g. The system shall store operator preferences based on logon information. This feature shall allow an operator to work with their preferred configuration independent of which workstation they occupy.
31. Operator Interface
    a. The SMS shall use a single client application interface for system configuration, administration, management, and monitoring operations.
    b. The SMS shall provide a mouse-driven, java-based, graphical user interface allowing operator(s) to open and work on multiple windows simultaneously, at host server and client workstation(s) with minimal degradation to system performance.
    c. The SMS shall provide a Web Browser based client-less interface that is capable of accessing the system from any authorized computer on the network regardless of the client computer operating system without requiring the loading or maintenance of any client software. The Web Browser interface must support industry standard SSL 128bit encryption.
    d. The ACMS shall provide on-line context sensitive help files to facilitate operators in the configuration and operation of the ACMS.
    e. The ACMS shall implement National Language Support (NLS) in a manner that allows simultaneous multi-lingual operation, based on individual operator language preference.
    f. The ACMS shall support defining an unlimited number of operators; application access via workstation(s) shall be restricted by operator login and password. Operator profiles shall be configurable to include

form level and field level permissions, database partition views, and language preference.

g. The ACMS shall provide primary and secondary menus that lead to input forms (screens) to add, change or delete information.
h. All ACMS forms shall support custom forms and templates that can be created based on an existing record or modifying a blank record.
i. All forms can be customized to include the fields and tabs of the operator's choice and be set as a default
j. The templates can them be used to generate new records with the necessary links already set up.
k. The ACMS shall provide the capability to create custom lists to appear on the operator's forms to satisfy specific requirements – such as a list box of company or division names
l. The ACMS shall provide definable templates for configuration wizards allowing an operator to create master templates for generating new records with the necessary links predefined
m. When a template is run, a Wizard guides the operator through the necessary steps to create a new record for the form
n. The system shall support generation of reports detailing the system operation. The following reports shall be available in the software:
    1) Cards on site
    2) Hours on site
    3) Cardholders with access to each door
    4) Access rights of each cardholder
    5) System Configuration
    6) Scheduled and Conditional Commands defined
    7) System operator transaction history
o. It shall be possible to replay video clips associated with events by directly interacting with the report as published to the computer screen.
p. The system shall demonstrate the ability to export data, for example reports, to other standard office word processing packages such as Microsoft Word.
q. The system shall provide system management reporting, including detailed listings for all the operator actions and the current cardholder database for output to the display screen, printer or disk media.
r. The system shall have the ability to save frequently used report configurations and associate them with a "Title". Such predefined reports shall be available from a list to simplify the report selection. It shall be possible to request these reports to run immediately or schedule them to occur at a specified date and time.
s. Scheduled reports shall additionally have the option to be automatically repeated by specifying the number of days and reporting period to be included, for example a weekly report of Alarms to run at 10:30 am each Monday and including the previous 7 days of Alarms.
t. The system shall allow custom reporting options by providing an interface to a commercially available 'off the shelf' reporting product, such as Crystal Reports. The interface shall present all database fields in a structured format, which does not require detailed knowledge of the database design and table relationships.
u. History Reporting
    1) Extensive reporting shall be included to provide the ability to review all system alarms, access control activity and operator

actions. These reports shall be available for review on the operator's display, to a printer, or to a file.

2) Extensive sort parameters shall include any of the personal details fields of information such as by department, job title, vehicle registration, contractor company name or any other reference appropriate for each site.
3) Frequently run report configurations shall be saved allowing them to be selected and run on demand, or scheduled to run automatically as required. When scheduled to run automatically this shall have the ability to be repeated.
4) Total Hours Spent On-Site
    a) This report shall provide a detailed audit of the arrival and departure times for cardholders and calculates the total time spent on site for the chosen reporting period. This report shall be filtered by any of the personal data fields of information associated with each cardholder.
5) Cards On-Site Reporting
    a) This report shall provide a list of cardholders currently on the site. This may be for all persons within the site or just who, for a particular department or a particular contractor company, is currently present. The report may also be run to cover just a part of the site, for example, cardholders is in a particular building or room.

32. The SMS server shall communicate to all clients (operator workstations and field hardware) through WIN32 services. The SMS server shall not require that an application be run for proper system operation.
33. Clients
    a. The system shall support an unrestricted number of clients to suit growing enterprise requirements. The system shall provide the means for multiple operators to simultaneously administer the system from convenient locations connected via a local area network (LAN) or across a wide area network (WAN).
    b. Systems that operate on the MSDE database server that restrict the number of clients shall be upgradeable to a fully unrestricted version of the software without the need for a database conversion.
    c. Clients shall not use mapped drives for server connections.
    d. Clients shall not use UDP messaging.
    e. System shall support a minimum of two client pc monitors. The system shall additionally store the last position and size of all open dialog boxes and screens upon exiting the application on a per operator basis. The next time the operator logs into the application, the screen positions shall be restored. Such operation shall be independent of which workstation the operator uses.
34. Addition of Cardholders to the System Database
    a. The system shall provide a means of assigning access control rights to each cardholder. Access control rights determine which access points are accessible to the cardholder based on date and time of day. The system shall support an unrestricted number of access rights.
    b. The software shall also provide an ALTERNATE set of Access rights to a cardholder on a temporary basis. The change may be initiated at any time by an authorized operator, or automatically between specified dates. This shall provide the facility of automatically changing a card's

rights between a specified date range, after which the card will revert to its normal Doors and Times. Alternate access rights shall be able to be configured for multiple date ranges.

c. Each cardholder shall either be associated with standard door timings, for door release, door open and door pre-held or be given extended timings for disabled persons or someone who has to push a cart.
d. Cardholders who have not used a reader for some time shall be readily listed to allow their card's status to be reviewed. An additional feature shall allow cardholders to be automatically set inactive and therefore access denied should the card have not been presented at any reader on the system for a defined number of days.
e. Cardholders shall be assigned an expiration date, and more specifically an expiry time, after which a card shall automatically become inactive and therefore be rejected at all readers on the system. To further simplify card administration, the system shall have the ability to be configured to automatically purge expired cardholder records after a configurable number of days from the date of expiration.
f. The system shall allow for the definition of Access control rights to be associated with a badge design. Each user that selects that badge design shall be provided with the associated access control rights that can further be customized for the specific cardholder.
g. The system shall allow access control rights to be defined for a cardholder on a reader basis. A time code will be associated with each reader as it is assigned to the cardholder's access control rights.
h. The system shall allow access control rights to be defined for a cardholder on a reader group basis. Reader groups are groups of readers. A timecode will be associated with each reader group as it is assigned to the cardholder's access control rights.
i. The system shall allow access control rights to be defined for a cardholder on an access code basis. An access code is a group of access control rights.
j. The system shall have a note field associated with each cardholder record. The note field shall be free form text and shall support a minimum of 256 characters. The note field shall further support the ability to attach a file (of any type or size) to the cardholder record.
k. When viewing a cardholder record the last twenty-five (25) valid door access transactions shall be displayed to help locate a cardholder.
l. A driver's license scanner shall be supported to simplify data entry of cardholder information. The scanner support shall include, at a minimum, the ability to automatically read, through optical character recognition, the most common fields from valid driver's licenses issued by all 50 states; and populate these fields into the appropriate user-defined personal data fields in the cardholder record.
m. The system shall support a field for assigning an approving official to the cardholder record that defines the individual who authorized the assignment of a credential. Approving officials shall have an associated validity period and image of their signature. As an option, the assignment of an approving official shall be mandatory.
n. The SMS shall allow the user to enroll biometric data as part of the cardholder enrollment process. The number of verifications to determine applicability of the enrolled biometric data shall be configurable.

35. Cardholder Details

a. Cardholder information shall include first and last name, card number, PIN code and valid period to provide automatic expiration. Each cardholder record shall also incorporate at least 50 user-defined personal data fields, independent of user-defined fields for visitor management.
b. Data entry shall be simplified by remembering previous entries of personal data and allowing selection from a pick list to minimize repetitive typing when creating each cardholder's record. The cardholder database and the history log shall also be sorted by any of the additional fields of information making them a powerful tool for filtering data.
c. Personal data fields shall support free entry text, picking an entry from a previously configured list, or picking an entry from an updatable list. Each of these entries shall further be categorized as a date, a time, general input, or customized input. Each category shall support the masking of input data to assure data integrity. For instance, a date mask might look like "mm/dd/yyyy" to indicate that the date input should be a two-digit month followed by a two-digit day followed by a four-digit year all separated by the slash character. The mask shall be required for customized input.
d. Personal data fields shall have the option of being configured as mandatory.

36. Locator
    a. This feature shall provide a quick method of locating cardholders by displaying the last 25 valid history events along with the time, date and access point used. This information shall be available for an individual or group of persons by name, card number or by personal data.
37. Card Watch Feature
    a. Any cardholder shall be easily tracked as they move around a large site by selecting card watch. As the person uses their access control card, the system shall have the ability to automatically notify the operator of the person's presence at each location.
38. Key Card Mode
    a. Key card mode authority shall be assigned to special cardholders, such as site key holders, and can be enabled on a per reader basis. This shall allow a person when vacating an area or building to change the reader's mode of operation from normal access control to Key Card Out operation.
    b. When in this condition only persons with key card privileges shall gain access through the door, all non-key card users are rejected regardless of their card's current access rights.
    c. This special feature shall be activated/deactivated by the key cardholder, using a card swipe followed by a special code entered via the reader's keypad.
39. Serial Device Interface
    a. The software shall allow the definition of ASCII commands to be sent out over a computer serial port (physical or virtual) or through the RS-232 interface of the DBU. These serial commands shall be available through the user interface as well as in the conditional logic described herein.
40. Automatic Holiday Override

a. The software shall be programmed by the operator to recognize special or holiday dates, which in turn can be linked to operational changes in how the site is to be managed on these specific days. This feature shall notify a system operator of individual holiday dates up to seven days prior provides a useful check on the date's current validity. Multiple types of holiday dates shall also be provided so that partial days or early closing requirements on specific dates can be accommodated.
b. The SMS shall provide a calendar function to enable scheduling of events up to five (5) years into the future.
c. The SMS shall provide the ability to schedule one-time events for up to five (5) years into the future.

41. System Partitioning
    a. The access point readers, monitor points, and auxiliary outputs shall be managed on a partition basis by simply defining which devices are to be included in a partition.
    b. The SMS shall support an unrestricted number of partitions.
    c. Multiple private or public entities shall be able to share the system with database segregation for card records and ownership of readers, monitor point inputs and switching outputs dependent upon the operator's assigned permissions. Each company partition shall allow for autonomous system administration, allowing partitioned card administration, reports, and alarms.
    d. Operator permissions shall be created and assigned globally or by the owning company. When created and assigned globally an Operator's password shall be associated with one or more companies.
    e. Alarm reporting shall be routed to a client located at the company owning the monitor point or reader and can be automatically redirected to a different PC at pre-programmed times and selective days of the week.
    f. Common areas, such as the main entrance, shall have the ability to be shared so that all companies may access these doors, even when different card customer/site codes have been configured.
42. Alarm Management
    a. Alarm handling shall be efficiently managed with up to 99 priority levels and user definable instruction messages to ensure the operator monitoring the site takes appropriate responses. The facility shall have the ability to customize audible alerts for each type of alarm is provided using standard or custom generated multimedia wave files. Each alarm type shall also be presented in a user-defined color.
    b. To provide additional information when reviewing alarm signals, the operator shall either enter custom comments or simply select from a predefined pick list to provide a time-stamped record of all the actions taken throughout the incident. Predefined manual commands shall be uniquely assigned for each alarm, and readily activated by the operator via a command button provided on the alarm acknowledgement screen. Additionally automatic conditional commands shall be configured to automatically operate in response to any given alarm condition.
    c. The SMS shall be optionally configured to require operator comments when acknowledging alarms.
    d. The SMS shall support the ability to selectively choose alarms to acknowledge and/or clear.
    e. Each alarm shall be configurable to have a specified color and sound.

f. Each alarm shall be capable of linking video from digital video recorders (if applicable) for incident playback.
g. The Alarm Monitor screen shall provide an indication that cardholder information is available for a specific alarm. A "Card" button shall be available that when pressed will display the cardholder badge image.
h. Alarm monitor screen shall support the display of alarm statistics, shall provide up to ten alarm filters to be displayed in different tabs on the alarm screen, and shall provide the ability to sort based on each different column.
i. Each alarm shall be time-stamped in the local time zone (not the server time zone), and the system shall support the additional display of labels associated with different geographical time zones such as PST, EST, GMT, etc. The labels for time zones shall be customizable.
j. The system shall permit the routing and display of real time activity at any standard client machine. Activity shall be shown in a dedicated activity window that is updated automatically when new transactions occur. This option shall not be limited to routing transactions to one location and shall support the simultaneous routing and display of real time activity at multiple locations.
k. Alarms shall be capable of being routed to specific client machines by time of day or day of week.
l. Unacknowledged alarms shall be capable of being routed to alternate client (or Email – see Software Options below) based on age and priority of alarm.
m. The display of reader door alarms shall be automatically enabled or disabled by the use of timed commands, either by reader or by a group of readers.
n. The system shall support a generic ASCII input capability that allows the system administrator to define specific ASCII input strings as alarms to be displayed in the alarm monitoring window as well as on the graphical map interface if so configured.

43. Graphical Site Maps (Provide as Alternate)
a. To further enhance the presentation to the operator, the system shall have the ability to import and use graphical maps. Maps shall be linked together using a tiered tree structure. To speed the location of an incident, each map level shall contain a clearly visible indicator as to which sub map the operator should select next to find the device that is in alarm.
b. Maps shall also have the ability to be configured to appear automatically on presentation of a new alarm, providing the operator with prompt visual indication that an alarm has occurred.
c. The status of readers, doors, monitor points and auxiliary outputs shall be requested from any map by simply selecting the icon representing the device and its current state will be displayed.
d. The icons on the graphic map shall dynamically indicate the status of the device they represent. For example, a door icon shall change to show the door open when the door position sensor indicates such, and shall change to the original icon when the door is again secure. Additionally, monitor points shall also change to show their current state.

e. Should the operator wish to change the current setting, simply pressing the right mouse button shall cause the appropriate command options list to appear for selection.
f. Having selected a command, confirmation shall be provided by reflecting the change in status on the display.
g. Maps shall be created using standard office tools such as Paint® or drawing packages such as AutoCAD®. It shall be possible to import drawings in the following formats: JPEG, Bitmap, Windows metafile or DXF.
h. Icons representing access points, monitoring points, switching outputs, alarm inputs, CCTV cameras or intercom call stations shall be placed on any map at the required location in a drag and drop manner.
i. It shall be possible to define on the map the location of readers, access doors, alarm monitored points, output switching relays, CCTV cameras, Digital Video Recorder Cameras, Intercom call stations and alarm panel devices. The map display shall allow the operator to switch the video display of any defined CCTV camera to any defined CCTV monitor. The map display shall allow the display of stored and live Digital Video Clips.
j. It shall also be possible to change the status of readers, reader groups, floor groups, alarm monitored points or output switching relays and confirm the successful execution of such commands from the map display. This functionality shall be capable of being restricted per device based on operator permission.
k. The map display shall include the option to display a group of similar devices as a single icon. Once devices are grouped it shall be possible to change their status. For example, it shall be possible to unlock all entrance doors by executing a single command from the map display.

44. Manual and Automatic Commands
a. Operators shall be provided with a wide choice of manual commands embracing the control of readers, monitor points, output switching relays and door locking devices. Also the operator shall have the ability to check the status of single, or multiple devices. This shall ensure the operator is always able to check the operational status of the system and make any adjustments as requirements change. When graphical maps are utilized, status requests shall be simply initiated by "clicking" on the device icon within the map. This functionality shall be capable of being restricted per device based on operator permission.
b. Automatic commands shall be included and may operate on a timed or event basis.
c. Scheduled commands shall easily be defined linking complimentary commands to occur at the start and stop times of any chosen timecode.
d. Event triggered commands shall provide an extremely powerful means of creating IF/THEN/WHEN associations encompassing a wide selection of IF conditions to the automatic execution of THEN commands subject to a WHEN timecode being active. A minimum of 10 THEN actions shall be available per trigger command.
e. Devices shall be managed on a partition basis by grouping readers, monitor points and auxiliary outputs. This feature shall allow multiple devices to be actioned by a single command when using manual, timed and conditional commands. This functionality shall be capable of being restricted per device based on operator permission.

f. The SMS shall support an unrestricted number of automatic (scheduled and trigger) and manual commands. These commands shall be capable of spanning across multiple field controllers.

45. Card Initiated Commands
    a. The software shall allow authorized cardholders to initiate powerful trigger commands manually from selected reader locations when certain models of readers are used in conjunction with the field panels.
    b. Up to 99 predefined commands shall be invoked by an authorized card allowing, for example, a patrolling guard to switch on outputs, disable monitor points, lock doors, providing remote management of the system during a patrol of the site.
    c. The system shall only permit assigned users to enter command codes at keypad readers. Such assigned users shall not be restricted as to when or where they can enter a command code – such restrictions may be placed on the commands themselves.
    d. User Code Mode
        1) The SMS shall support the ability to put a keypad-equipped reader into User Code Mode. This feature shall allow a cardholder to gain access by entering a valid card's number at a reader keypad, therefore not requiring the holder to carry a card.
        2) User code mode shall be enabled on a per reader basis.
        3) This mode shall support card number only, or card number and its assigned PIN code.
46. Device Configuration
    a. The system shall support a notes field to be associated with each device configured on the system. The notes field shall be free-form text, and shall support a minimum of 256 characters. The notes field may be used for detailed device descriptions or for maintenance history. The notes field shall also allow files to be associated.
    b. The system shall provide a hierarchical tree view of the system configuration supporting expansion and collapse of any and all branches.
47. Windows Daylight Saving Auto Adjustment
    a. The system shall support Windows Time Srv or Windows time management.
48. History Archive and System Back up
    a. The system shall allow on line archiving of history logs, along with database back up of system configuration and cardholder details. To further ease the burden of remembering to back up your system's database, this function shall be able to be automated to occur without intervention at a pre-set time.
    b. The system backup and history archive shall be to a magnetic tape drive at the database machine, or the system may be configured with a destination drive and path located on a different PC accessible to the Database machine via the network.
49. Anti-Passback
    a. The system shall support both "hard" Anti-Passback and "soft" Anti-Passback alarm reporting modes.
    b. If the cardholder has access rights at a reader, but creates an Anti-Passback alarm, if the reader configured as hard anti pass-back sends an Anti-Passback alarm and denies access to the door/portal.

c. Soft anti pass-back sends an Anti-Passback alarm, but still allows access through the door/portal.
d. The system shall support timed anti-pass back. The principle of timed anti pass-back is simple: once a card has been used at a timed anti pass-back reader, the card causes an Anti-Passback violation if it is used again at the same or another timed anti pass-back reader within a predefined period of time. The exception to this rule is when the Anti-Passback reader has been defined to be for an exit route. In this case, the card can be used at any time without causing an alarm or event. This allows for situations where a person enters an Anti-Passback protected area, then wishes to exit the area immediately, perhaps, for example, because he or she forgotten something.
e. The use of an exit anti-pass back reader also causes the time delay for reuse of the card to be zeroed, so in the example, the person can re-enter the anti-pass back-protected area immediately, without having to wait. The delay can also be zeroed from the Card Holders screen or by means of an anti-pass back command. Sending a command may be useful if, for example, people have passed through an exit during a fire drill and the delay is long.

50. Provide Manufacturer:
    a. Software House C-Cure 800
        1) Access Panel: ACP (8 Door Controller)
        2) Model #: As required by the owner

B. Furnish & Install all ancillary devices which shall be compatible with the specified Access Control System and Intrusion Alarm/Central Station Monitoring or the approved equal. All devices and finishes shall be coordinated and approved by the architect prior to installation. Provide the following components:

1. Card Readers HID/ASSA ABLOY
    a. Manufacturer: ASSA ABLOY/HID
    b. Part #: RP-40 (HID Multi-Class)
    c. Or approved equivalent
2. Panic/Duress Button
    a. Manufacturer: HONEYWELL
    b. Part # 269R Series Panic Switch
    c. Or approved equivalent
3. Door Contacts (Recessed)
    a. Manufacturer: GE
    b. Part # 1076W (wide 1 inch gap)
    c. Or approved equivalent
4. Request to Exit Push button
    a. Manufacturer: Schlagle
    b. Part #: 620 Series
    c. Or approved equivalent
5. Request to Exit Sensor (PIR)
    a. Manufacturer: Bosch
    b. Part #: DS-150i with Trim plate TP 160
    c. Or approved equivalent
6. Intrusion Alarm Panel (Central Station Communicator)
    a. Manufacturer: Honeywell
    b. Part #: Vista Series with Wireless Receiver
    c. Or approved equivalent

7. I/0 CONTROLLERS
   a. Manufacturer: Software house (Tyco)
   b. Part #: I8 and R8 input/put modules
   c. Or approved equivalent

8. Local Alarm (Audible)
   a. Manufacturer: DSI
   b. Part #: ES-411 (with auto-reset audible timeout)
   c. Or approved equivalent
9. Electrified Mortise Lock
   a. Manufacturer: ASSA ABLOY
   b. Part #: L9080 WITH REQUEST TO EXIT FUNCTION
   c. Or approved equivalent
10. Power Supply (Locks)
   a. Manufacturer: Altronix
   b. Part #: AL600ULXD- 6 Amp 12-24vdc with Battery Backup
   c. (7amp Battery)
   d. Or approved equivalent
11. Access Control Power Supply
   a. Manufacturer: Software House
   b. Part #: APS w/Enclosure with Battery Backup
   c. (7amp Battery)
   d. Or approved equivalent
12. Card Reader Cabling (Composite-Plenum)
   a. Manufacturer: CSC Cable, West Penn, Windy City Wire
   b. Part #: CSC P/N: 112110 (Plenum)
   c. Part #: West Pen P/N: AC251822 (Plenum)
   d. Part #: Windy City P/N: 4461095-S (Smart Wire-4 Plenum)

C. Miscellaneous Materials. Provide all cabling, connectors, mounting hardware, interface modules, software, manuals, instructions and miscellaneous items necessary for a complete, fully installed and functional system, ready for the Owner's use. ALL MECHANICAL DOOR HARDWARE SHALL BE FURNISHED BY OTHERS (electric locks, magnetic door strike, strikes, etc.).

D. Labeling and documentation of all cables, boxes, devices, and hardware installed under this contract.

E. Testing and test documentation as described below.

F. Ancillary Devices. Key pads, PIR detectors, panic buttons, door contacts, glass break detectors (audio type) etc. shall be compatible with specified the alarm panel or the approved equal. All devices and finishes shall be coordinated and approved by the architect prior to installation.

G. Miscellaneous Materials. Provide all cabling, connectors, mounting hardware, interface modules, software, manuals, instructions and miscellaneous items necessary for a complete, fully installed and functional system, ready for the Owner's use.

H. Labeling and documentation of all cables, boxes, devices, and hardware installed under this contract.

I. Testing and test documentation as described below.

2.3 VIDEO MANAGEMENT SYSTEM (VMS) (Existing)

A. Furnish & Install all CCTV hardware as depicted on drawings, or approved equal, complete with all hardware necessary for a complete and functional system. The system shall have ample capacity to accommodate future growth. Provide the following components:
   1. Performance Requirements
      a. Complete CCTV video recording management solution in a compact design.
      b. Capable of high resolution H.264 video compression.
      c. Provide system wide recording, monitoring, and management of fixed and PTZ cameras.
      d. Simultaneous live display, recording, playback, network transmission, and back-up.
      e. Stable embedded operating system.
      f. Rack mountable.
   2. Field replaceable hard drives, accessible via the front without uninstalling the unit from the application.
   3. The VMS shall have flexible, open architecture built on accepted industry standards that facilitate integration with IT infrastructures.
      a. Flexible and scalable CCTV management system in an easy to use versatile design.
      b. View, record, control cameras, handle alarms and check device status through one interface.
      c. Real-time digital recording and playback at 25/30 IPS in CIF, 2CIF and 4CIF resolution on all channels simultaneously.
      d. Real-time live display at 25/30 IPS in 4CIF resolution for greater detail as needed (independent of recording settings).
      e. Multiple control options via USB mouse, front panel and joystick keyboard.
      f. Remote configuration and management of devices on surveillance system.
      g. Powerful search and playback functions.
      h. Hybrid recording of 8 or 16 analog cameras and up to 16 H.264 IP channels with a variety of hard drive capacities.
      i. Internal storage up to 8 TB on four front-accessible hard drives.
      j. Lip-Synchronous audio/video.
      k. Video player with image authentication (watermarking).
      l. NTSC and PAL selectable video format (auto detected).
   4. Field replaceable hard drives, accessible via the front without uninstalling the unit from the application.
   5. The VMS shall have a distributed fault-tolerant, failover database architecture. The distributed server architecture allows for each subsystem to operate in an independent mode, without affecting video recording or live viewing.
   6. The database video storage shall provide minimum of 20 days of high quality at 7.5 fps 2 CIFF resolution quality. The overall storage shall be based on real time recording and motion detection no less that 50 percent of motion activity and H.264 compression scheme.
   7. The VMS shall possess an internal watchdog to detect and recover from the unlikely occurrence of system lockup.

8. The VMS shall provide support for IP (network) cameras from multiple third party manufacturers.
9. The VMS shall not use multiplexing or timed division technology for analog video recording. All analog camera sources shall be digitally recorded.
10. The VMS shall be able to support video motion detection natively. This operation can be executed by the edge device or the IP Camera. Enabling motion detection shall be performed either:
    a. On a continuous basis
    b. Scheduled for particular times, dates, days, months, etc.
    c. Defined areas of interest through an easy-to-use user interface using simple editing tools
    d. At a defined level of sensitivity
11. The VMS shall support software designed for the Microsoft® Windows® 2003 or Windows XP operating systems.
12. The VMS shall support local language translation, including languages that do not support the European character set, such as Chinese.
13. All text displayed in the user interface shall be stored in a database to allow for easy translation to another language.
14. The VMS shall support both single and multi-site deployments.
15. The VMS shall be designed to work with cameras that generate a standard NTSC or PAL composite video signal.
16. The VMS shall support a variety of video matrix switcher devices, code generators, and PTZ cameras from different manufacturers.
17. The recorders will use a standard Ethernet connection for video input via TCP/UDP/IP.
18. The VMS shall be capable of supporting large organizations with systems at multiple site locations linked via LAN / WAN connections.
19. Provide the following components:
    a. Fixed Color Indoor/Outdoor Dome IP/
        1) Manufacturer: American Dynamics (Dome PoE Camera)
        2) Part # Illustra 600 with ceiling mount kit
        3) Or approved equivalent
    b. Power Supplies and battery backup
        1) Manufacturer: Altronix
        2) Part # R2432UL (Rack Mount)
        3) Or approved equivalent
    c. UPS
        1) Manufacturer: Tripp
        2) Part # 3KVA Smart Pro tower and rack Mount
        3) Or approved equivalent
    d. Cabling (Coaxial and Power)
        1) Manufacturer: CommScope
        2) Part # 2054K/2054V
        3) Or approved equivalent
    e. Video Network Recorder/VMS (Existing)
        1) Manufacturer: ONssi
        2) Part # IP Licenses as required
    f. Encoders for analog cameras (Elevator)
    g. Video Transceivers
        1) Manufacturer: NVT
        2) Part #: NV-214A-M
        3) Part #: 8-channel Video Transceiver Hub Model NV-813S

4) Or approved equivalent

h. POE Network Switch
   1) Manufacturer: Interlogix
   2) Part # 24 Port Switch Giga bit Ethernet Managed switch
   3) POE on all 24 Ports 15.5 watts/port, 2x 1 Gbt backbone
   4) 4 x SFP ports copper.

i. CCTV Monitors
   1) Manufacturer: Bosh
   2) Part #: LCD 19" High Resolution Monitor Model # UML-19P-90

20. Ancillary Devices such as cameras, lenses, camera mounts, camera enclosures, recorders, switch gear, etc. shall be compatible with the overall system design intent. All devices and finishes shall be coordinated and approved by the architect prior to installation.
21. Miscellaneous Materials. Provide all cabling, connectors, mounting hardware, interface modules, software, manuals, instructions and miscellaneous items necessary for a complete, fully installed and functional system, ready for the Owner's use.
22. Labeling and documentation of all cables, boxes, devices, and hardware installed under this contract.
23. Testing and test documentation as described below.

2.4 RELATED WORK NOT INCLUDED IN THIS SECTION AND SPECIFIED ELSEWHERE, UNLESS OTHERWISE NOTED.

A. Electrical outlets.

B. Standard electrical boxes with ¾-in conduit stub ups to ceiling.

C. Cutting, patching, and painting.

2.5 WARRANTY

A. Warranty all portions of the work against faulty and improper material and workmanship for a minimum period of one (2) year from date of final acceptance by the Owner. Where warranty for a longer term is offered through a manufacturer/installer certification program, such longer term shall apply.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GROUNDING

A. Comply with Division 16 Section "Grounding and Bonding."

B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

C. Ground cable shields, drain conductors, cabinets and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drains conductors to ground at only one point in each circuit.

3.3 LABELING/IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in Division 16 Section "Electrical Identification" and with TIA/EIA-606.

B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
   2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

C. At completion, cable and asset management software shall reflect as-built conditions.

3.4 FIRE STOPPING

A. Seal all penetrations through fire rated walls, floors and walls created by or made on the behalf of the contractor so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electric Code.

B. Use sealant material that has passed fire exposure testing in accordance with standard time-temperature curve in the standard, UL, ASTM E 119, and NFPA 251 and the hose stream test in accordance with UL 1OB.

3.5 TESTING

A. Test all components installed under the contract.

B. Pre-installation Inspection
   1. Visually inspect items and shipping cartons for damage. Return visibly damaged items to the manufacturer.
   2. Prior to testing, submit for review and approval copies of test report forms proposed for use. Forms shall, at minimum, contain: Project name; Contractor’s name; Date of test; Type and description of test, and test criteria for acceptance.

C. Post Installation Testing
   1. Submit Test and Acceptance Plan to owner for approval prior to testing.
   2. Test only completed systems. Partial testing is not acceptable.
   3. The Consultant reserves the right to observe the conduct of any or all portions of the testing process and to conduct, and to require the Contractor, using the Contractor’s equipment and labor, a random re-test.

4. Document all test results and corrective procedures and submit to the Consultant within ten (10) working days of test completion.

3.6 TRAINING

A. User Training.
   1. Provide up to 8 hours of system and software training in at least two separate sessions for 2 to 5 members of the owner's staff. Provide an additional follow-up training session of up to two hours within 6 week of final acceptance.
   2. All training shall be on the Owner's premises using the installed system.
   3. Provide telephone technical support to the Owner for a minimum of one year after acceptance of the system.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system.
   1. Develop separate training modules for the following:
      a. Computer system administration personnel to manage and repair the system and databases and to update and maintain software.
      b. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
      c. Security personnel.
      d. Hardware maintenance personnel.
      e. Corporate management.

3.7 SYSTEM SOFTWARE

A. Develop, install, configure and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.8 ACCEPTANCE

A. Once the testing has been completed, as-built and testing documentation delivered to the Owner and the Owner is satisfied that all work is in accordance with the contract documents, the Owner will notify the contractor in writing of the acceptance of the work performed. The date of this acceptance shall constitute the commencement of the warranty period.

3.9 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
   1. Prepare and issue access cards and finalized database for Owner's operators, management, and security personnel.
   2. Train security personnel.

END OF SECTION

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