

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Piping materials and installation instructions common to most piping systems.
2. Excavating and backfilling associated with piping systems.

1.2 DEFINITIONS

A. **KROGER DIRECT BUY PROGRAM:** Owner supplied/Contractor installed.

1. The Kroger Company will supply many plumbing related items directly from the manufacturer. The Owner will provide equipment and the Contractor will install.
2. Comply with requirements in Division 00 Section "General Conditions."

B. **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, crawlspace, and tunnels.

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

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

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

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

1.3 SUBMITTALS

A. Unless otherwise specified and in addition to provisions of Division 00 Section "General Conditions," submit drawings having each sheet, and each page of a brochure, marked with identification and containing information described below. Submittals are to be complete, partial submittals will not be accepted.

B. Identification:

1. Include project name and Architect's job number. If pages are securely bound in brochure, this is needed on cover only.
2. Identification by specification section and article under which equipment or material is described, and by name, number and intended use as designated by contract drawings and specifications.

3. When more than one item of equipment is covered by a single drawing or catalog cut, each project equipment item must be separately identified thereon with clear delineation as to which model or catalog number or performance data applies to each project item.

C. Information:

1. Include manufacturer's model number or catalog number, size and other data as requested.
2. Maintenance Manuals: Organize each maintenance manual with index and thumb-tab marker for each section of information; bind in 2-inch (51-mm) 3-ring, vinyl-covered binder, with pockets for folded sheets, properly labeled on spine and face of binder.

1.4 QUALITY ASSURANCE

- A. Application: Comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to extent more detailed and stringent requirements are indicated or required by governing regulations.

- B. Listing of Associations, Standards and Abbreviations Specific to Plumbing Work (in addition to standards specified in individual work sections), conform to following applicable standards:

1. AABA - Associates Air Balance Council
2. AGA - American Gas Association
3. AMCA - Air Movement & Control Association
4. ARI - Air/Conditioning and Refrigeration Institute
5. ASC - Adhesive and Sealant Council
6. ASHRAE - American Society of Heating, Refrigeration & Air Conditioning Engineers
7. ASME - American Society of Mechanical Engineers
8. ASPE - American Society of Plumbing Engineers
9. ASSE - American Society of Sanitary Engineering
10. AWS - American Welding Society, Inc.
11. AWWA - American Water Works Association, Inc.
12. AAGI - Compressed Air and Gas Institute
13. CISPS - Cast Iron soil Pipe Institute
14. EPA - Environmental Protection Agency
15. FM - Factory Mutual System
16. MCA - Mechanical Contractor's Association of America
17. NIST - National Institute for Standards and Technology
18. (NBS) (formerly National Bureau of Standards)
19. NEC - National Electrical Code by NFPA
20. NEMA - National Electrical Manufacturer's Association
21. NFPA - National Fire Protection Association
22. NSF - National Sanitation Foundation
23. OSHA - Occupational Safety and Health Administration (U.S. Department of Labor)
24. PDI - Plumbing and Drainage Institute
25. SMACNA - Sheet Metal & Air Conditioning Contractors National Associations, Inc.
26. TIMA - Thermal Insulation Manufacturers Association
27. UL - Underwriter's Laboratories, Inc.

- C. Symbols: Except as otherwise indicated in drawing legends, refer to "ASHRAE Handbook of fundamentals" for definitions of symbols used on the drawings to show plumbing work.

- D. Manufacturers: Firms regularly engaged in the manufacture of products of quality, types and sizes required; and which have been in satisfactory use of not less than four years in similar service, except as otherwise noted in specific sections of this division.
- E. Installer's Qualifications: Firm with at least three years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.
- F. Compatibility: Provide products which are compatible with other products of the plumbing work and with other work requiring interface with the plumbing work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.
- G. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- H. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- I. 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.
- J. 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.

1.5 DESCRIPTIONS

- A. "Kroger Supplied" and "Contractor Supplied" equipment is described in Division 00 Section General Conditions." Unless the Drawings indicate that it Kroger supplied, the Contractor is responsible for supplying the equipment as shown on Drawings.
- B. Section specifies provisions for plumbing work, including:
 - 1. Certain adaptive expansions of requirements specified in Division 00 Section General Conditions", uniquely applicable to plumbing work.
 - 2. General performance requirements within plumbing work (all Division 22 Sections) as a whole.
 - 3. General work to be performed as plumbing work, because of its close association with plumbing work.
- C. Examine all Drawings, and available soil reports. Visit site and become acquainted with all conditions which may affect execution of work.

- D. Provide work in accordance with state and local codes, regulations and/or ordinances, and meet approval of authorities having jurisdiction. Provide only new material and as specified.
- E. Furnish to Owner, a Certificate of Final Approval from governing authority prior to Owner's final acceptance, where applicable.
- F. Comply with all requirements for permits and licenses, and pay all associated costs.

1.6 PERFORMANCE REQUIREMENTS

- A. General Outline: The facilities and systems of the plumbing work include all Division 22 Sections.
- B. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.7 COORDINATION OF PLUMBING WORK

- A. Refer to Division 00 Section "General Conditions" for general coordination requirements applicable to entire work. The Contract Documents are diagrammatic in showing certain physical relationships which must be established within plumbing work, and in its interface with other work, including utilities, control and electrical work, and that such establishment is Contractor's exclusive responsibility.
- B. Arrange plumbing work in a neat, well organized manner, with piping and similar services running parallel with primary lines of the building.
- C. Give right-of-way to piping which may slope for drainage.
- D. Locate operating and control equipment properly to provide easy access, and arrange entire plumbing work with adequate access for operation and maintenance.
- E. Advise other trades of openings required in their work for the subsequent move-in of large units of plumbing work (equipment).
- F. Strictly adhere to invert elevations for all underground piping. Pitch piping evenly between pipe junctions and where indicated on the drawings. Piping, not installed at invert elevations indicated on the drawings, shall be removed and re-laid at Contractor's expense.
- G. Coordination of Drawings: For locations where elements of plumbing (or combined plumbing and electrical) work must be sequenced and positioned with precision in order to fit into the available space, provide coordination drawings (shop drawings) showing the actual physical dimensions (at accurate scale) required for the installation. Prepare coordination drawings prior to purchase/fabrication/installation of any of the elements involved in the coordination. Submittals are not required by the Owner or the Architect, unless otherwise noted.

PART 2 - PRODUCTS

2.1 Compatibility: Provide products which are compatible with other products of the plumbing work and with other work requiring interface with the plumbing work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.

2.2 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Protect products against dirt, water, chemical and mechanical damage. do not install damaged products.
- B. Deliver products to site in factory fabricated containers, with the manufacturer's label clearly visible. Handle carefully to avoid damage to components, enclosure and finish, and in strict accordance with manufacturer's instructions.
- C. Store products in clean dry place in original containers, protected from weather and construction traffic.

2.3 **JOINING MATERIALS**

- A. Refer to individual Division 22 Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 **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 minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 PLUMBING SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. 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.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch 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 PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: Polished chrome-plated with set screw.
- D. Split-Casting, Cast-Brass Type: Polished chrome-plated with concealed hinge and set screw.

2.8 GROUT

- A. 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, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.9 PLUMBING SYSTEM IDENTIFICATION:

- A. Signs:
 - 1. Stencil-Painted Identification: Lettering size not less than **1-1/2-inches (38-mm)**.
 - 2. Engraved Plastic-Laminate Signs: Sufficient size to convey adequate information at each location. Comply with recognized industry standards for color and design.
 - 3. Operational Tags: Plasticized card stock, with pre-painted or hand printed, to convey the message; example: "DO NOT CLOSE THIS VALVE EXCEPT WHEN BURNER IS OFF". Provide proper and adequate information on operation and maintenance of plumbing systems.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 00 Section "General Conditions" 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.
 - 6. 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 EXCAVATING AND BACKFILLING FOR PIPING SYSTEMS

- A. See Division 31 Section "Earth Moving" for excavation and backfilling for exterior underground piping installations and Division 33 Sections for site utilities.
- B. Excavate and backfill utility trenches for piping systems as specified in Division 31 Section "Earth Moving" and as follows:
 - 1. Perform all excavation and backfilling required for installation of piping systems. Consult with utilities prior to beginning excavation.
 - 2. Comply with codes of authorities having jurisdiction. Provide slope sides, shore and brace as required for stability.
 - 3. Remove all materials encountered in obtaining indicated lines and grades as shown on Drawings. No extras will be allowed due to variations of proportion and the variation of materials.
 - 4. Lay piping on a bed of sand **6 inches (152 mm)** deep well tamped into place and properly graded to permit the pipe to have an even bearing throughout its entire length. Install sand around the piping and to a point **6 inches (152 mm)** above the piping.
 - 5. Pipe Trench Backfill: Above granular pipe fill, place inert soil, approved by the geotechnical engineer, in **4 to 6 inch (100 to 150 mm)** thick lifts uniformly compacted to 95 percent Standard Proctor density (ASTM D-698).
 - a. Owner will test trench backfill to confirm that adequate compaction is being achieved. Submit **50 pound (23 kg)** bag of proposed trench fill to Owner's geotechnical engineer four days before use, for approval and Standard Proctor laboratory testing.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems:
 - 1. 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.
 - 2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 - 3. 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.
 - 4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - 5. Install piping to permit valve servicing.
 - 6. Install piping at indicated slopes.
 - 7. Install piping free of sags and bends.
 - 8. Install fittings for changes in direction and branch connections.
 - 9. Install piping to allow application of insulation.
 - 10. Select system components with pressure rating equal to or greater than system operating pressure.
 - 11. Install escutcheons for penetrations of walls, ceilings, and floors.

12. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
13. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and plumbing sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.
 - a. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - c. Plumbing Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble plumbing 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.
14. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using plumbing sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.
 - a. Plumbing Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble plumbing 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.
15. Verify final equipment locations for roughing-in.
16. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
17. Where a pipe slot is indicated for a group of pipes passing through a wall, set a rectangular frame of structural angles, welded in the slot, at each side of wall. Close each side of opening with two No. 16 USG galvanized steel plates cut to fit the pipes and/or pipe insulation closely, and fasten to angle frame. For slots in exterior walls, slip flanged ferrules of sheet metal on pipes when they are installed, with flanges inside the closure plates at exterior wall face, caulk ferrules and plates to make weathertight joint, and pack space between closure plates with rock wool or glass fiber. At slots in fire walls, pack as specified above, but omit ferrules and caulking. Escutcheons are by Division 22.
18. Pipe Sleeves:
 - a. For pipes passing through brick or concrete walls, or concrete floor slabs, provide steel pipe sleeves, two (2) sizes larger than the pipe for which they are intended. Coordinate setting of sleeves as construction progresses. Set sleeves flush with finished line of walls and floors.
 - b. Caulk sleeves through foundation walls to make them watertight.

3.4 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 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.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are 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 plumbing 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. Install equipment to allow right of way for piping installed at required slope.

3.7 INSTALLATION OF EQUIPMENT AND PIPING

- A. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start-up
- B. Mount and align equipment in strict accordance with manufacturer's recommendations and in accordance with procedures described below. In case of conflict, these procedures govern. Where structural or miscellaneous steel is not drilled, drill in field as directed.
- C. Lubricate all equipment as required and in accordance with manufacturer's recommendations. Furnish required lubricants.
- D. Neatly cut all openings in roof decks as needed for equipment and pipe penetrations.
- E. Suspended Equipment and Piping:
 - 1. Provide structural steel and steel rod hangers. Weld (with approval of Architect where attaching to building steel) structural steel hangers or bolt with hex head machine bolts and with spring lock washers under nuts.
 - 2. For suspension from concrete, provide steel or malleable iron inserts in poured concrete construction, as specified for pipe hangers and supports, and expansion shields, toggle bolts or lag screws, in other construction. Use electric drill with carbide bit for drilling concrete blocks.
 - 3. For suspension from structural steel, use beam or channel clamps with locking clips.
 - 4. Do not support plumbing components from ceiling grids.

5. Do not suspend hangers from roof decks.
 6. Suspend from roof trusses and joists/joist girders only at panel points, at top cord only, unless otherwise indicated.
 7. Provide additional supports wherever needed, and structural steel members attached to building frame to provide additional points of support where required. Do no drilling or building structural and miscellaneous steel, except as directed or indicated.
- F. Equipment Set on Structural Steel: For bolting equipment directly to structural steel, provide machine bolts, lock washers and nuts.
- G. Floor-Mounted Equipment: Set and level equipment on foundation. Grout in place, using non-ferrous grout. Provide wedges and shims for leveling.
- H. Accurately align equipment prior to operation.
- I. Refer to Division 00 Section "General Conditions" for general close-out requirements. Maintain daily log of operational data on plumbing equipment and systems through the close-out period; record hours of operation, assigned personnel, fuel consumption and similar information; submit copy to Owner.
1. Turn Over of Operation: Upon substantial Completion, turn over prime responsibility for operation of plumbing equipment and systems to Owner. However, until time of final acceptance, respond promptly with consultation and services, as required. Provide one operating engineer, who is completely familiar with the work, to consult with and continue training Owner's personnel.

3.8 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. 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 the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement steel and/or mesh as specified in Division 03 Section "Cast-In-Place Concrete Slabs."

3.9 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.

3.10 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.

3.11 PLUMBING SYSTEM IDENTIFICATION

- A. Provide engraved plastic-laminate signs at locations of major equipment units, primary control devices, emergency equipment, dangerous elements of plumbing work and similar places. Mount permanently in an appropriate and effective location.
- B. Operational Tags: Provide proper and adequate information on operation and maintenance of plumbing systems.

3.12 INSPECTION

- A. Installer must examine areas and conditions under which products are to be installed. Notify Owner, in writing, of conditions detrimental to proper completion of work. Starting of installation constitutes acceptance.

3.13 CUTTING AND PATCHING

- A. Comply with Division 00 Section "General Conditions" for cutting and patching of other work, to accommodate the installation of plumbing work. Except as individually authorized by the Owner or the Architect, cutting and patching of plumbing work to accommodate the installation of other work is not permitted, other than necessary penetrations of plumbing sheet metal work for electrical conduit and similar purposes.

3.14 TRIMMING

- A. Inspect pipe supports, in occupied and equipment spaces for sharp angles which protrude into path of occupants and may cause injury. Trim such protrusions or cover with suitable spongy material to prevent such injuries.

3.15 TOUCH-UP

- A. Touch-up with zinc dust-zinc oxide primer galvanized or steel equipment which has been welded or otherwise scarred. Provide additional finished equipment of paint type and color to match original.

3.16 SYSTEM TESTS

- A. Perform all system tests in the presence of Owner. Notify Owner of all system's tests at least 48 hours in advance.

3.17 SYSTEM INSPECTION

- A. All systems are to be inspected by Owner before covering, enclosing or concealing of work. Notify Owner of all systems which are to be covered, enclosed or concealed at least 48 hours in advance.

3.18 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
 - 1. Clean surfaces that will come into contact with grout.
 - 2. Provide forms as required for placement of grout.
 - 3. Place grout, completely filling equipment bases.
 - 4. Place grout on concrete bases and provide smooth bearing surface for equipment.
 - 5. Place grout around anchors.

END OF SECTION 22 05 00