

DIVISION 22 PLUMBING

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Unless stated otherwise, the standards in this Facilities Design Manual (FDM) are directed to the Design Professional to incorporate into the Project.

Although the Owner encourages improved concept, method and product recommendations by the Design Professional, deviation from these standards, including product requests for "approved equivalent" status, requires written justification from the Design Professional and written approval from the Owner's Representative before completion of Design Development Documents.

22 05 00 PLUMBING COMMON WORK RESULTS

A. REFERENCE ABBREVIATIONS

1. ANSI American National Standards Institute
2. ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers
3. NFPA National Fire Protection Association

B. GENERAL

1. When new roof openings are required for existing buildings, verify with the Owner's Representative whether the roof is under warranty.
 - a. If under warranty, comply with the roof manufacturer's details to prevent voiding the warranty.
2. Verify utility availability at the site with the Owner's Representative.
3. Specify the Contractor consult the Owner's Representative to coordinate service connections to existing systems.
 - a. See FDM Part 2/[Div 33 Utilities.pdf](#).
4. For pipe material, see FDM Part 2/Support Docs for Div 21-23/[ISU Standard Pipe Schedule And Specifications.pdf](#).

C. DESIGN REQUIREMENTS

1. Comply with the State Building Code and Boiler And Pressure Vessel Rules.
 - a. See paragraphs under sub-section 02.02 and 02.05 in FDM Part 1/[Sec 02 Codes And Regulations.pdf](#).
2. Lay out piping parallel to building lines where practical.
3. Lay out pipe adequately sloped with drain valves located at low points to facilitate complete draining.
4. Design so that branch lines are connected at the top of the main line.
5. Lay out equipment with adequate clearance to service tubes, filters, strainers, valves, specialties as well as for the general replacement of pipe sections and parts.
 - a. Locate sufficient unions and flanges to permit independent removal of equipment.
6. Do not locate plumbing or other piping in the following spaces.
 - a. Transformer vaults
 - b. Elevator shafts
 - c. Elevator equipment rooms
 - d. Telecommunications equipment rooms
7. Provide full access to a 3 foot minimum width pipe space for restrooms.
 - a. Design water closet, urinal drain and sink piping layouts using long sweep fittings to locate cleanouts within the pipe space and 6 inches above the highest drained fixture overflow level.
8. Except for sanitary and storm piping, do not bury piping mains under floor slabs.
 - a. Install accessible piping tunnels where practical.

D. EXPANSION FITTINGS AND LOOPS

1. For steam application, specify externally pressurized expansion joints that have inconel 625 bellows with a full travel 10,000 cycle life and a 5 year warranty.
 - a. Install joints with alignment guides that comply with standards of the Expansion Joint Manufacturers Association.

E. METERS

1. For gas, domestic water and condensate, size meters furnished by the Owner and installed by the Contractor.

2. Specify expected demand for meters as follows.
 - a. Natural Gas Meters
 - 1) Provide for auxiliary enterprise facilities only.
 - 2) Provide regulator and dielectric fittings.
 - b. Domestic Water Meters
 - 1) Locate at the entrance to all facilities.
 - 2) See Detail U-DW-2 within Domestic Water Details in FDM Part 2/Support Docs for Div 33/[Utility Mechanical Details](#).
 - c. Steam Condensate Meters
 - 1) Specify for all services.
 - 2) Specify the meter located 10 pipe diameters downstream from the condensate receiver and 5 pipe diameters before leaving the building.
 - d. Chilled Water Meters
 - 1) Provide for auxiliary enterprise facilities only.
3. Consult the Owner's Representative for installation requirements.

F. GAGES

1. The Owner has a Building Automation System (BAS) that sends gage readings to a central location.
2. Gages or gage openings are required on piping systems to facilitate operation of the system.
3. Specify a gage range of 1.5 times the normal working pressure of the fluid being measured.
4. Specify gages on systems as follows.
 - a. Where a gage will be used by an operator on a regular basis, specify a physically installed gage.
 - b. Where a gage will be used by an operator on a regular basis and the application is of a differential pressure nature (pumps, strainers, etc.), specify one physically installed gage and piping to either side of the differential.
 - c. Where a gage is needed for occasional use but not every day by an operator, specify a pressure/test plug installed instead of a physically installed gage.
5. Specify gages of at least 4 inches in diameter for piping systems readable without the use of a ladder.
6. Specify snubbers for gages serving pumps.

G. GENERAL-DUTY VALVES

1. Show valve locations on Drawings.
2. Specify valves manufactured in the USA.
3. Specify valves located to isolate branch sections of main lines.
4. Specify isolating valves on all items subject to repair or replacement.
5. Specify Circuit Setter balancing valves by Bell and Gossett (<http://www.bellgossett.com/productPages/Parts-Circuit-Setter.asp>) or approved equivalent.
 - a. Install on each heating and cooling unit and at each hot or chilled water pump.
 - b. Size balancing valves based on flow, not on pipe size.
6. For steam and condensate return service, specify the following valve types.
 - a. Butterfly type with gear drive operator for sizes 2.5 inches and larger.
 - b. Ball type with proper rating for sizes 2 inches and smaller.
7. Specify slow closing operators for high-pressure applications.

H. HANGARS AND SUPPORTS

1. For cold lines supported by pipe hangars, specify the hanger located outside the insulation bearing on a metal insulation shield or insulating block.

I. IDENTIFICATION

1. Piping
 - a. Provide pipe coding for all piping.
 - 1) Specify wording/color combinations comply with ANSI A13.1 standards.
 - 2) Specify Setmark pipe markers by Seton Identification Products (<http://www.seton.com/seton/catalog/browseSpaceCode.do/100002/H65.html>) or approved equal.
 - a) Do not specify pressure-sensitive type markers.
 - b. Protect underground mechanical and plumbing piping runs with buried pipeline marker.
 - 1) Specify 3 inches wide by 6 mil fluorescent yellow polyethylene marker tape imprinted to read "Caution - Buried Pipe Below".
 - 2) Specify tape placed 1 foot directly above top of pipe over entire length of run.
 - 3) Specify tape placed directly on a 4 inch deep by 6 inch wide layer of clean white sand.
 - c. Specify the replacement of any existing tape encountered, removed or disturbed during excavation as described in paragraphs under 22 05 00J2b and as approved by the Owner's Representative prior to backfilling.
2. Valve Tags
 - a. Specify valves identified by a securely attached brass valve tag conforming to ANSI A13.1-1984-3.4.
 - b. Specify installation documentation include label number, valve location and function.
3. Insulated System Components
 - a. Specify system components concealed by insulation, such as valves, strainers, unions, etc., labeled on the outside of the insulation covering.

22 07 00 PLUMBING INSULATION

A. PIPING INSULATION

1. Specify pipe insulation to comply with or exceed minimum thicknesses stated in ASHRAE/IES 90.1-1989, Codified Version.
2. Specify products comply with NFPA Sections 90A and 90B with special regard to fire hazard classification requirements of NFPA No. 255, latest revision, including vapor barriers and adhesives.
3. Specify products with a flame spread rating of not over 25, without evidence of continued progressive combustion, and a smoke developed rating no higher than 50.
4. Specify cold piping with complete vapor barrier protection.
5. Insulate the following systems.
 - a. Cold potable water piping
 - b. Roof drain piping
 - c. Hot potable water piping
 - d. Plumbing vents five feet from roof
 - e. Storage water heaters

22 08 00 PLUMBING COMMISSIONING

A. CLEANING OF POTABLE WATER PIPING

1. Specify the following flushing procedure.
 - a. Operate flush valves, faucets and other valves as needed until flow is clean.
 - b. After flushing, remove inlet strainers, aerators and other devices, thoroughly clean and replace.
 - c. Remove valve assemblies to clean out foreign material when necessary and replace assemblies.
2. Specify the following disinfecting procedure and requirements.
 - a. Provide necessary connections at beginning points of individual sections of mains to apply chlorine for disinfecting purposes.
 - b. Verify the system is complete, flushed, and clean prior to starting work.
 - c. Ensure the pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
 - d. Inject disinfectant (free chlorine in liquid, powder or tablet form) throughout the system to obtain a 50 to 80 mg/L residual.
 - e. Bleed water from outlets to ensure distribution, and test for disinfectant residual at a minimum of 15 percent of outlets.
 - f. Maintain disinfectant in the system for 24 hours.
 - g. If final disinfectant residual tests less than 25 mg/L, repeat the treatment.
 - h. Flush disinfectant from the system until the residual is equal to that of incoming water or 1.0 mg/L.
 - i. Take samples no sooner than 24 hours after flushing, from 2 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

B. CLEANING OF DEIONIZED WATER PIPING

1. Specify the following procedure and requirements.
 - a. For sterilization, furnish chemicals that do not exceed 1 percent chlorine concentration in the sterilization tank.
 - 1) Where approved by the Owner's Representative, use hydrogen peroxide instead of chlorine.
 - b. With the complete system operating, including UV sterilizers, fill the system with deionized water.
 - c. Remove air from the system.
 - d. Perform a pressure test not including the tank.
 - e. Balance water flow to branches.
 - f. With the circulating pump running, slowly add chlorine to the storage tank until total system chlorine content is at least 50 PPM.
 - 1) Continue to circulate for 6 hours.
 - 2) Comply with the State Plumbing Code.
 - g. Drain the system and refill with deionized water.
 - h. Run the system at full capacity for three days with the reverse osmosis system on manual and excess water eliminated via the tank overflow drain.
 - 1) Do not allow chlorinated water to pass through the reverse osmosis water membrane.
2. Specify the Owner's Representative observe sterilization and cleaning operations.

C. TESTING OF POTABLE WATER PIPING

1. Specify the following procedure and requirements.
 - a. Test piping underground and in chases and walls before piping is concealed.
 - b. Test piping before insulation is applied.
 - 1) If insulation is applied before pipe testing and a leak occurs which ruins the insulation, specify damaged insulation is replaced with new insulation by the Contractor at no cost to the Owner.
 - c. Test piping with 100 psig water pressure or equivalent inert gas such as nitrogen.
 - d. Hold test pressure for a minimum of 8 hours.
2. Specify the test witnessed by the Design Professional if requested by the Owner's Representative.

D. TESTING OF SANITARY, STORM, AND ACID WASTE AND VENT PIPING

1. Specify the following procedure and requirements.
 - a. Test piping with water to prove tight.
 - b. Test piping before insulation is applied.
 - c. Hydrostatically test soil, waste, and vent piping inside the building with 15 feet head of water and allow to stand for 1 hour for inspection before connecting fixtures.
 - 1) If a leak appears, repair and repeat the test.
 - d. Hydrostatically test interior downspouts with 15 feet head of water and allow the water to stand for 1 hour with no leak.
 - e. Water test force mains at a pressure equal to 1.5 times the operating pump discharge pressure.

E. TESTING OF GAS PIPING

1. For low pressure up to 1 psi, specify the following procedure.
 - a. Test piping with 20 psi air pressure and hold for 2 hours without showing a drop in pressure.

F. TESTING OF REMAINING PIPING

1. Specify the following procedure and requirements.
 - a. Test piping to a pressure of 150 percent of normal operating pressure and hold for 1 hour without showing a drop in pressure.
 - b. Test piping using water, nitrogen or air compatible with the final piping service.
 - 1) Do not specify use of combustible liquids or gases.

22 11 00 FACILITY WATER DISTRIBUTION

A. PIPING

1. Specify piping in compliance with the Owner's standard pipe schedule and applicable code requirements.
 - a. See FDM Part 2/Support Docs for Div 21-23/[ISU Standard Pipe Schedule And Specifications.pdf](#).
 - b. Consult the Owner's Representative in case of conflict.
2. Design using pipe sizes that allow water flow in pipes that comply with the State Plumbing Code.
3. Specify dielectric unions or dielectric couplings installed where two dissimilar metals are in contact.
4. Do not specify plastic pipe for supply piping inside buildings unless required for pure water piping.
 - a. Verify with the Owner's Representative.
5. Verify with the Owner's Representative before specifying acid waste piping for laboratories.

B. SPECIALTIES

1. Backflow Preventers
 - a. Isolate domestic water from cross connection using a backflow preventer in the domestic water line.
 - b. On the main domestic water line to the building, locate two reduced pressure zone type backflow preventers sized at 60% capacity and piped in parallel to allow the Owner to test each device without taking the entire building out of service.
 - 1) Specify an epoxy lined soft seat style check valve installed in the incoming pipe directly ahead of the backflow preventer.
 - 2) Specify dielectric between dissimilar metals.
 - 3) For backflow preventer details, see FDM Part 2/Support Docs for Div 21-23/[Plumbing Details](#).
 - c. Design floor sinks and stand pipes that serve reduced pressure backflow preventers with enough capacity to accept full flow discharge from the backflow preventer.
 - 1) Design to prevent discharge from running across the floor to a floor drain.
 - d. On the fire prevention system serving the building, use a double check type or other type of backflow preventer as determined by analysis of risk to the domestic water service.
 - 1) Where a portion of the fire prevention system contains an elevated risk such as a glycol loop, consider specifying an additional back flow preventer for that portion of the piping.
 - e. Contact the Owner's Representative for a copy of the Owner's Domestic Water Back Flow Prevention Program.
2. Pressure Reducing Valves
 - a. Near the entrance of the main domestic water line to the building, locate a direct acting pressure reducing valve immediately after the water meter.
 - b. Size the pressure reducing valve to provide a maximum of 60 psi water pressure within the building.
3. Floor Drain Traps
 - a. Specify floor drain traps of sufficient depth to keep traps primed at all times.
 - b. Where trap primer devices are required by code or adequate trap depth is not possible, specify a trap primer device mounted on a wall and the primer discharge piping routed under the floor.
4. Vacuum Breakers
 - a. Specify vacuum breakers on all faucets with hose connections, including lab faucets, but exclude distilled water faucets.
 - b. Locate fume hood water service vacuum breakers outside the hood.
 - 1) Contact the Owner's Representative for design criteria.

C. PUMPS

1. Wherever possible, specify Bell & Gossett pumps (<http://www.bellgossett.com/>).
2. Specify pumps with motors, starters, controls, strainers, pressure gauges, vibrations isolators, check valves, and isolation valves.
3. Specify a pump schedule that indicates number, capacities, pressures, motor horsepower, rpm, and other pertinent data for all pumps in the Project.
4. Specify bronze fitted hot water pumps.
5. Specify chilled water pumps with stainless steel sleeves.
6. Specify pumps mounted on a concrete pad above the finished floor with vibration isolators, where required, to block the transmission of sound or vibration.
7. Specify a fine mesh startup strainer and a running size mesh strainer are supplied with all pumps.
8. Because split casing pumps have high repair costs, specify end suction pumps wherever possible.

9. Specify circulating pumps have gate, ball, or butterfly valves on either side of the pump.
 - a. Do not specify a check valve for a stop function.
10. Specify the inlet minimum size equal to 7 straight diameters, or otherwise specify suction diffusers.
11. Do not specify pumps that require removal from the system piping for servicing the impeller.
12. Specify submersible pumps for sewage ejection and sump pumping applications.
13. For condensate pumps, specify a union, check valve, and stop valve at discharge connections.
14. Specify mechanical seals for all pumps.
15. Locate pumps with adequate service space.
 - a. Do not locate pumps tight to ceilings or walls.
16. If triple duty valves are used, specify an additional isolating valve to insure tight shut off of the system for pump maintenance.
17. Chilled water pumps are not required.
 - a. Verify with Owner's Representative for each project.

22 30 00 PLUMBING EQUIPMENT

A. STEAM WATER HEATERS

1. Specify steam fired instantaneous or semi-instantaneous water heaters.
2. Specify water heaters with copper lining and a minimum 10-year warranty on tank and heat exchanger.
3. Specify a working pressure of 150 psig.
4. Specify pressure vessels are stamped with the proper designation required by the state Boiler and Pressure Vessel Rules.

22 00 00 PLUMBING FIXTURES

A. GENERAL

1. Specify matching plumbing fittings with visible parts chrome plated or another finish approved by the Owner's Representative.
2. Wherever possible, specify fixtures from a single manufacturer.
3. Specify mounting height and connections sizes.
4. Specify ADA compliant fixtures as required, mounted at the required height.
5. Specify loose key stops at all plumbing fixtures.
6. Specify loose key hose bibs at all exterior walls of the building.
 - a. Specify Model B65 freeze proof type wall hydrants by Woodford Manufacturing Company (http://www.woodfordmfg.com/Woodford/Wall_Hydrant_Pages/model65.htm) or approved equal.
7. Specify photometric valve operators where approved by the Owner's Representative.
8. Specify piping penetrations covered with escutcheon plates.
9. Specify plumbing fixtures are installed tight fitting to the wall and neatly sealed at the joint with silicone sealant.

B. TOILETS AND FLUSH VALVES

1. Specify wall hung, rear outlet, rear supply spud, white vitreous china water closets with the following features.
 - a. Siphon jet flush valve type with elongated bowl and black open front seat with check hinge
 - b. Floor mounted steel/cast iron support carrier assembly
 - c. High efficiency water usage of 1.28 gallon per flush maximum.
 - d. Maximum Performance (MaP) test results of no less than 750 grams per single flush.

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- e. Flow-matched to concealed, hard wired, auto-sensor flush valve with exposed nominal 4 x 4 stainless steel sensor plate from the same manufacturer
2. Coordinate flush valve sensor plate location with grab bar location.
 3. Specify toilets and flush valves by one of the following manufacturers or an equivalent product approved by the Owner's Representative.
 - a. American Standard (http://www.americanstandard-us.com/assets/documents/amstd/spec/SpecSheet_1950.pdf)
 - b. Sloan (<http://www.sloanvalve.com/Specifications/WETS-2060-1311-1.28-ESS.pdf>)
 - c. Zurn (<http://www.zurn.com/operations/ecovantage/pdfs/specsheets/83460.pdf>)

C. URINALS AND FLUSH VALVES

1. Specify wall hung washout flush valve type urinals with the following features.
 - a. Rear supply spud
 - b. Integral side panels
 - c. Floor mounted steel support carrier assembly
 - d. High efficiency water usage of 0.13 gallon per flush maximum
 - e. Flow-matched to concealed, hard wired, auto-sensor flush valve with exposed nominal 4 x 4 stainless steel sensor plate from the same manufacturer
2. Specify urinals and flush valves by one of the following manufacturers or an equivalent product approved by the Owner's Representative.
 - a. Sloan (http://www.sloanvalve.com/Specifications/WEUS-1010.1311-0.13_ESS.pdf)
 - b. Zurn (<http://www.zurn.com/operations/ecovantage/pdfs/specsheets/81431.pdf>)

D. LAVATORIES AND FAUCETS

1. Except where a single wall hung lavatory is required by the Building Program, specify lavatories molded integral with the counter top or self-rimming white vitreous china lavatories with perforated or grid drains.
 - a. For single wall hung lavatories, specify white vitreous china supported by a steel carrier assembly.
2. Specify lavatory faucets that comply with ASME A112.18.1 and ASME A117.1 and have the following features.
 - a. Single hole deck mounted type fixture
 - b. Infrared sensor(s) to activate and de-activate water flow of 0.5 gallons per minute maximum
 - c. Option to set automatic water flow safety shut off at 30 seconds
 - d. Option to set sensor distance to 4 inches
 - e. Sensor powered by hard wired AC/DC transformer
 - f. Single supply for tempered water from under-counter-mounted thermostatic mixing valve
3. Specify faucets by one of the following manufacturers or an equivalent product approved by the Owner's Representative.
 - a. American Standard Moments Selectronic 2506 Series (http://www.americanstandard-us.com/assets/documents/amstd/spec/SpecSheet_2751.pdf)
 - b. Chicago Faucet Hytronic Series or E-Tronic Series (<http://www.chicagofaucet.com/catalog/catalog.php?CategoryID=ELECT>)
 - c. Delta Teck 590T0 Series (<http://www.specselect.com/PDFs/DSP-590TRevA6.pdf>)
 - d. Moen 8306 (<http://www.moen.com/shared/pdf/commercial/8305sp.pdf>)
 - e. Sloan Optima ETF-880 Series (<http://www.sloanvalve.com/Specifications/Optima ETF-880.pdf>)
 - f. Speakman Sensorflo S-8800 (<http://www.speakmancompany.com/products/detail/S-8800>)
 - g. Zurn AquaSense Z6913 Series (<http://www.zurn.com/operations/aquaflushsense/pdfs/specsheets/80667.pdf>)

4. For lavatory faucets used where water may be used for drinking or cooking, specify a “lead-free” product by one of the following manufacturers or an equivalent product approved by the Owner’s Representative.
 - a. Speakman Sensorflo S-8800-CA (<http://www.speakmancompany.com/products/detail/S-8800-CA>)
 - b. Zurn AquaSense Z6913-XL Series (<http://www.zurn.com/operations/aquaflushsense/pdfs/specsheets/200175.pdf>)

22 40 00 EMERGENCY PLUMBING FIXTURES

A. GENERAL

1. Provide eye washes and safety showers to meet Owner standards.
 - a. Consult with the Owner’s Representative.

22 47 00 WATER COOLERS

A. GENERAL

1. Specify a “lead free” material certificate from the water cooler manufacture prior to installation.
2. Specify only high efficiency units.
3. Specify Elkay VRCGRN series units (<http://www.elkayusa.com/cps/rde/xchg/elkay/hs.xsl/96606.aspx>), Halsey Taylor HVRGRN series units (<http://www.halseytaylor.com/HVRGRN.html>) or equivalent product approved by Owner.

B. ACCESSIBLE UNITS

1. Locate water coolers along accessible routes.
2. Specify 50% of water coolers accessible for persons in wheel chairs and 50% of water coolers accessible for standing persons.
3. Comply with requirements for DF Drinking Fountains in “Access for Everyone”.
 - a. See paragraphs under 02.07B Accessibility Standard in FDM Part 1/[Sec 02 Codes and Regulations.pdf](#).

C. WATER COOLERS WITH FACTORY INSTALLED GLASS FILLER / FILTER OPTION

1. To encourage use of refillable water containers with high quality water instead of using purchased bottled water, specify water coolers near main building entrances with glass filler / filter option.
 - a. On remaining floors, specify one water cooler per floor with a glass filler / filter option.
2. Specify the factory installed option that includes a push lever gooseneck style glass filler and activated charcoal water filter offered by Elkay and Halsey Taylor or equivalent option approved by Owner.
 - a. For specifications of the option offered by Elkay, see <http://igate.northernplumbing.com/specsheets/elkay/lk1110.pdf> and <http://www.freshwatersystems.com/products/specifications/51299C.pdf>.
 - b. For specifications of the option offered by Halsey Taylor, see <http://www.drinkingfountaindoctor.com/297/pdfs/Universal-Glass-Filler.pdf> and <http://www.freshwatersystems.com/products/specifications/55897c.pdf>.
3. Specify submittals to include operation and maintenance requirements.

22 52 00 FOUNTAIN PLUMBING SYSTEMS

A. GENERAL

1. Specify recirculating type fountains equipped with timers to operate only when needed.
2. Specify that information on cleaning, chemical treatment, and general maintenance is furnished to the Owner.

22 61 00 LABORATORY COMPRESSED AIR SYSTEMS

A. GENERAL

1. Normally the Owner will furnish compressed air systems from the central campus compressed air system at 90 psi.
2. Specify a local compressor for backup.
3. Specify the compressed air is filtered at the point of application for the specific use.

22 63 00 LABORATORY GAS SYSTEMS

A. GENERAL

1. For each laboratory served by natural gas, locate an emergency shut-off valve or switch by the main room exit to turn off the gas supply to that room.
 - a. Where electrically operated valves are used, specify them to fail closed.
 - b. Where ball valves are used, specify them UL listed for natural gas.
 - 1) Specify the valve control to include a relay that requires manual reset after a power outage or emergency shutdown.
 - c. Provide a sign indicating the purpose of the valve or switch.

END OF DIVISION 22 PLUMBING