

Division 22 – Plumbing

22.1. General

- a. All piping systems shall be hydrostatically tested after installation. The test pressure shall be 200 PSI or 1 1/2 times the working pressure, whichever is greater. Components not suitable for a 200 PSIG test may be tested at a lower pressure and then valved off for the 200 PSIG test. Test duration on pipe with soldered joints shall be at least two (2) hours; the test duration on pipe with mechanical joints shall be 24 hours.
- b. The A/E shall note in specifications that water lines shall be disinfected and tested for bacteria at the completion of project.
- c. The A/E shall show underground / under-slab utilities on a separate drawing at the foundation level.

22.2. Common Motor Requirements for Plumbing Equipment

- a. Integral horse power electric motors shall be Totally Enclosed Fan Cooled (TEFC) premium efficiency. Open Drip Proof (ODP) motors are not acceptable.

22.3. Sleeves and Sleeve Seals for Plumbing Piping (floor and wall penetrations)

- a. Pipe sleeves at floors should extend two (2") inches above adjoining finished floor surface to serve as a dam in any area where flooding is possible due to nearby plumbing fixtures or mechanical equipment.
- b. If the slab is core drilled for pipes, provide sleeve as noted above.

22.4. Meters for Plumbing Piping

- a. Domestic water meters shall be installed at each building and shall be capable of showing cumulative gallons and of measuring the actual flow rates.
- b. Irrigation systems, hot water loop, chilled water loop and cooling tower make-up shall be metered separately.
- c. Fire protection service shall not be through the domestic metered water system.
- d. All meters shall be back-net capable of tying into the HVAC system.

22.5. Valves for Plumbing Piping

- a. The installation of isolation valves in university buildings requires the engineer assess the building from a maintenance view. Buildings should be valved to allow for shutdown based on the type of occupancy. For example a residence hall, which has a number of private bathrooms, should be valved to allow Facilities Management staff to repair student bathrooms without turning off the water to the entire building, an entire floor or even an entire wing. This is also true of a science building where shutting down an entire building or floor could pose a risk to research and instruction.
- b. Stop valves are not considered isolation valves.
- c. The A/E shall review with the Facilities Management staff an isolation valve scenario for each building during the preliminary design submittal review. Valves shall be shown on the drawings.
- d. Provide the following valves, as a minimum:
 - i. All buildings shall be supplied with a main water cutoff valve within 10' of an exterior wall of the building. Cut off valves shall be within 5' of every fire hydrant.
 - ii. Water service (Interior) shut-off valves are shall be located on each floor
 - iii. On take offs from all vertical risers and branch lines.

- iv. At each floor in branch line serving that floor (provide 2 valves if system is looped).
 - v. Hot and cold water at entry to each bathroom.
 - vi. Each service (water, gas, comp air, etc.) at entry to each laboratory and at each lab bench, fume hood, and at terminations for equipment. Valves shall be readily accessible and grouped together.
 - vii. Drain valves shall be installed in accessible locations at all low points in the piping system to permit drainage and servicing.
 - viii. The A/E shall determine need for any application specific additional valves that may be required.
- e. The A/E shall require, as part of the specifications an as-built valve directory. All valves shall be individually numbered and tagged to correspond with valve directory. Tags shall be stamped brass tags or discs secured with non-ferrous beaded chain. Valve numbers shall be engraved or stamped as large as possible on tags (1 inch by 2 inches) or discs (1.25 inch diameter) attached to the valves by 10-gauge brass "S" hooks.
 - f. All valve boxes shall be raised to ground level.
 - g. When metallic piping is located outside mechanical rooms or closets, provide lockable access doors for all isolation valves, hammer arrestors and trap seal primer valves serving the domestic water systems.
 - h. Provide threaded ball valves on all lines up to 3" (no sweat valves). Flanged ball valves on all lines up to and including 6". Submit a variance request (**APPENDIX B - DESIGN STANDARDS VARIANCE REQUEST FORM**) for any butterfly valves specified.
 - i. Pressure reducing valves (PRV) shall be provided in all buildings at the domestic water entrance just downstream of the meter. Provide a full size bypass loop around the PRV and meter and a strainer with blow down valve upstream of the meter bypass loop. PRVs shall be suitable for the application and the A/E shall verify the prevailing mains water pressure and consult the manufacturer's engineering department to verify the correct selection of the PRV. Provide inlet and outlet shutoff valves and by-pass valve. Provide pressure gauge on valve outlet.
 - j. Valves shall be compatible with piping materials. Non-ferrous full port ball valves up to four inches (4") can be used on domestic water. Non-ferrous or ductile iron butterfly valves can be used on two and one-half inches (2 1/2") and above. Gate valves shall not be used except where provided with backflow prevention devices.
 - k. No dielectric unions / fittings - use threaded bronze body valve, bronze nipple in place
 - l. Six-inch (6") long brass nipples shall be used when connecting piping of dissimilar metals.

22.6. Identification for Plumbing Piping and Equipment

- a. All piping and equipment in mechanical equipment rooms and central plants shall be completely painted according to the "**SCHEME FOR THE IDENTIFICATION OF PIPING SYSTEMS,**" **ANSI A13.1** and the "**SAFETY CODE COLOR FOR MARKING PHYSICAL HAZARDS,**" **ANSI Z53.1**, latest revisions, for letter size, length of color field, colors, and viewing angles of identification devices for piping.

22.7. Plumbing Piping Insulation

- a. All domestic hot, cold and tempered water piping shall be insulated and shall be continuous through floors, walls and studs. Condensation is an issue on campus and shall be carefully considered by the A/E when developing the specifications.
- b. Insulation shall be performed fiberglass pipe insulation with vapor barrier and an all service jacket.

22.8. Water distribution Piping

- a. In renovations where plumbing fixtures are removed but not replaced, domestic water pipes shall be removed to within five (5) pipe diameters of the main to prevent leaving a long dead leg, and terminated with a capped ball valve. Where plumbing fixtures are removed but the water pipes will be reused the pipes shall be capped to prevent debris from entering pipes.
- b. Domestic water pipe shall not be installed in or under concrete slabs on grade, except where necessitated by building entrances or under sidewalks.
- c. Closed water piping systems shall have air vents to purge any trapped air.
- d. New construction shall not allow dead leg runs.
- e. The use of domestic water for process (i.e. water cooled ice machines) cooling is prohibited.

22.9. Sanitary Waste Piping Specialties

- a. Floor Drains: Drains shall be provided in all sprinkler valve rooms, restrooms, cooling towers, mechanical rooms and any other area subject to either continuous or intermittent wetting.
- b. Cleanouts: Floor cleanouts are preferred over wall cleanouts where possible. Location of clean outs shall consider aesthetic and functional conditions to avoid pour placement, such as in a doorway or high traffic areas such as lobbies. Cleanout locations shall be reviewed by the A/E and the University Architect during Preliminary design. Cleanouts shall be adjustable and equipped with an internal brass plug with counter sunk brass screws holding rim to body cover. Wall cleanouts shall be stainless steel round access covers. Consider the floor or wall materials where the clean out would be installed and find alternate solutions where higher end materials such as terrazzo floors or wood paneled walls are present. The A/E shall clearly show all clean outs and access on drawings and review prior to bidding.
- c. All cleanouts at or above the ceiling shall be brought to the floor level of the fixture being served.
- d. Provide cleanouts on exterior sanitary and storm lines within 5 feet (5') of the building.

22.10. Storm Water Systems

- a. All storm lines shall be continuous from the inlet to the storm system outside the building.

22.11. Sanitary Waste Systems

- a. Pumped discharge lines from sewage and storm ejectors shall not be combined with gravity drains inside buildings. Pumped and gravity drains shall run separately to the nearest manhole.
- b. All underground sanitary piping shall be GPS located and those coordinates shall be reflected on as-built drawings.

22.12. Water Heaters

- a. Gas fired domestic water heaters are proffered.
- b. Water heaters, 50 gallons or less, can be electric.
- c. Administrative and other buildings may utilize electric domestic water heaters.
- d. Instantaneous or semi-instantaneous heaters shall be used for all domestic hot water loads. Provide temperature control devices for domestic water heaters. Domestic hot water storage tanks, where approved, should be set to 140 degrees Fahrenheit (140° F).

- e. To conserve energy, domestic hot water storage systems and domestic hot water recirculation pumps shall have an input from the BAS (Building Automation System) so they can be turned back or off during scheduled unoccupied times.
- f. Use chemical sterilization and/or booster heater systems for dishwashing needs instead of higher temperature supply hot water.

22.13. Plumbing Fixtures

- a. Provide cut sheets on all plumbing fixtures during preliminary design for review by the University.
- b. Residence Halls: Refer to **BCOM TECHNICAL BULLETIN T-006** for the required toilet fixture waiver associated with R-1 / R-2 Use Application.
 - i. The A/E shall submit the required waiver with the Preliminary Submittal to BCOM. The A/E can choose to submit the waiver with the schematic submittal.
 - ii. *The request must identify and compare the type and duration of the transient housing occupancy to the number, distribution and accessibility of plumbing fixtures.*
- c. All bathroom fixtures shall be caulked with 100% silicone sealant matching fixture color, typically white.
- d. All exposed piping in toilet rooms (unless concealed by an apron) shall be chrome plated brass.
- e. All plumbing penetrations in non-fire rated walls shall be caulked air tight with acoustical caulk.
- f. Acceptable Manufacturers for flushometers and hands free lavatory faucets:
 - i. Moen
 - ii. Sloan
 - iii. Toto
- g. Acceptable Manufacturers for shower valves and shower heads:
 - i. Moen
 - ii. Symmons
 - iii. Kohler Commercial
- h. Acceptable Manufacturers for Kitchen Sinks
 - i. Moen
 - ii. Kohler Commercial
 - iii. Elkay
- i. **Standard and ADA Water Closets:** WaterSense-Certified White Vitreous China, Floor-mounted, Elongated Bowl,
- j. **Water Closet Flushometer:** WaterSense-Certified.1.28 GPF exposed, sensor-activated, piston-type, chrome-plated with mechanical override.
- k. **Urinals:** WaterSense-Certified White Vitreous China, Wall-Mounted, Washout Action, Flushometer: WaterSense-Certified 0.125 GPF exposed, sensor-activated, piston-type, chrome-plated with mechanical override. Waterless urinals shall not be permitted.
- l. **Counter Lavatory:** Solid surface integral bowl sink.

- m. **Wall-Mount Lavatory (including hand wash sinks):** ADA Compliant, White Vitreous China
- n. **Public Rest Room Lavatory Faucets:** hands free sensor, chrome plated, cast brass construction, single mount, vandal resistant aerator, .5 gpm (1.9 L/min) vandal-resistant multi-stream laminar flow, solenoid operations shall be battery operated with an 8 year minimum battery life, or automatically recharged during operation.
- o. **All other Lavatory Faucets:** Provide wrist paddles.
- p. **Service Sink:** Floor mounted, precast concrete or stone construction; 8" or 12" maximum height from floor to rim, 24" x 24" (minimum size). Faucet – Back-mount, chrome, vacuum breaker, integral stops, spout with pail hook and hose end, checks to eliminate cross-flow.
- q. **Floor Drains:** Installed in all restrooms, centrally located with floor slightly sloped toward drain, 6" inlet with 2" outlet, chrome plated brass or nickel bronze.
- r. **Exterior wall hydrants:** shall be spaced at a maximum of 100 feet (100') around the entire building, but not less than one hydrant per major exterior wall. Freeze-proof concealed wall hydrants with extended stems can be supplied from interior partitions perpendicular to exterior walls. Wall hydrants shall be automatic draining with a key lock.
- s. **Interior Hose Bibs:** Provide a hot & cold water key-operated hose bib in all multi fixture public restrooms, locate under lavatories. All mechanical equipment rooms, glycol tanks and cooling towers shall be equipped with a hose bib. Provide a hose bib in roof penthouses.
- t. **Shower valve:** Brass construction, 1/2" PEX connections with integral stops, pressure balancing, four port, cycle valve, adjustable temperature limit stop to control maximum hot water temperature, pressure balancing mechanism maintain selected discharge temperature to $\pm 3.6^{\circ}\text{F}$, brass cartridge, Metallic/nonferrous and stainless steel materials.
 - i. No PEX shall be used larger than $\frac{3}{4}$ ".
- u. **Shower heads:** WaterSense Certified, heavy duty, solid brass and chrome-plated with no removable parts. Shower valves and shower heads shall be installed on a sidewall in the shower unit so that the spray from the shower head does not spray toward the threshold or shower curtain.
- v. **Shower Basins:** Off-site fabricated shower basins shall be of solid polymer construction. Shower stall walls shall be finished with $\frac{1}{4}$ " solid surface polymer panels. Panels shall extend overlap at least 2" below top of shower basin on all walls in shower stall. Panel and base material shall be from the same manufacturer. Installation of shower basin connections to drains through slab shall be properly aligned and water tight.
 - i. Refer to **DIVISION 1 – GENERAL REQUIREMENTS** for shower mock ups.

22.14. Residential Housing Student Bathrooms Plumbing Fixtures

- a. Water Sense fixtures are required, when available.
- b. Note: Public restrooms within residence halls which shall follow the fixture standards above
- c. **ADA Roll in Shower and ADA Transfer Shower:** provide a zero threshold shower with a floor drain adjacent to and outside the shower.

- d. **Standard and ADA Water Closet:** Floor mounted, tank type, two piece vitreous china toilet with bottom outlet, elongated bowl, universal height, SanaGloss finish, chrome trip lever, 1.28 gallons per flush (GPF), Commercial plastic elongated seat with closed front and cover. Seat and cover shall include soft close hinge system
- e. **Standard and ADA Vanity Sink:** Sink basin shall be integral counter mounted type. Provide ADA compliant offset tailpiece and insulation kit on piping below fixture when required.
- f. **Vanity Sink Faucet:** ADA compliant, water sense, chrome plated brass, 4" center set single handle faucet with metal pop-up waste assembly, adjustable temperature limit stop and vandal resistant aerator
- g. **Wall Hung Lavatory:** ADA compliant, water sense, 21"x18" wall hung, vitreous china lavatory, 4" faucet centers, front overflow
- h. **Standard and ADA Shower Basin & Enclosure:** Single Fiberglass unit without ceiling enclosure, OR solid surface basin and wall panels. Provide 2" shower drain with stainless steel strainer and securing nut in each shower compartment.
- i. **Standard Shower Valve and trim:** water sense, manual pressure balancing mixing valve with adjustable temperature limit stop, lever handle and low flow showerhead. Provide with chrome plated arm and flange.
- j. **ADA Shower Valve and trim:** water sense, manual pressure balancing mixing valve with check stops, level handle and low flow showerhead (1.5 GPM). Provide head from same manufacturer as valve assembly. Provide with chrome plated arm and flange; Provide with ADA hand held showerhead (1.5 GPM) on slide bar. Diverter to control showers heads shall be provided; Provide diverter between shower arm and head at each fixed showerhead.
- k. **Staff Apartment, Student Kitchen Sink, and Lounge Sink:** Two compartment, 18 gauge, under mount, type 304 stainless steel sink with drain opening in center rear of each compartment. Provide basket strainers with tailpiece. Sink faucets shall be 8" (min.) center set with 8" spout with single handle faucet, ceramic disc cartridge with 1.5 GPM aerators. Provide 17-gauge chrome plated offset tailpiece and 17-gauge chrome plated cast brass p-trap with cleanout. Provide supplies to wall with wheel handle angle stops. No sprayers. Provide wrist blades at faucets.
- l. **Staff Apartment Bath Tub:** Tub fixture to be minimum 60"x30"x14" high fiberglass with slip resistant surface, integral apron; Provide Shower head and valve as noted for student showers above.

22.15. Emergency Plumbing Fixtures

- a. Where research and teaching labs are required to have Emergency Eye/Face Wash and Emergency Showers, provide a recessed barrier-free swing-down eye/face wash with drain pan and shower safety station with ceiling mounted exposed shower head combination unit.
- b. Where surface mounted Emergency Eyewash / Faucet combination units are required to supplement recessed swing-down emergency wash units, provide Faucet Eyewash Combo unit with the following features:
 - Combined gooseneck faucet with independently operated eye-wash.
 - Twin aerated eyewash sprays, with flip-top dust covers.
 - Eyewash activation by clearly delineated handle.

- Faucet handles shall be minimum 4-inch wrist blade handles for hot and cold water supplies operating quarter-turn ceramic cartridges (25 year cartridge warranty).
 - Eyewash faucet location shall be further identified by appropriate wall mounted or ceiling suspended signage.
- c. Valves should be spring loaded to prevent continuous flow.

22.16. Drinking Fountains

- a. Acceptable Manufacturers
- i. Halsey Taylor
 - ii. Elkay
 - iii. Murdock
- b. Combination Drinking Fountain / Bottle filling Station: Provide wall mounted stainless steel electric drinking fountain with bi-level dual fountain cooler and bottle filling station, ADA compliant, no touch sensor activation on bottle filler, cooler shall have push bar activation, non- filtered, non-refrigerated.
- c. Exterior drinking fountains shall be frost proof type.

22.17. Laboratory Compressed Air Systems

- a. Air-cooled rotary screw compressors are preferred for system needs greater than 50cfm
- b. Ascertain that proper ventilation is available for compressor location.
- c. Provide liquid-cooled compressors when ventilation is inadequate.
- d. Control air pressure shall be monitored and alarmed through the DCC when the pressures are outside the range of acceptable pressures as determined by the owner.
- e. Control air compressors shall have the following features:
- External, disposable, cartridge-type oil filter
 - Positive pressure lubrication system
 - Loadless starting
 - Automatic condensate purge piped to drain
- f. Compressed air systems shall have refrigerated driers.
- g. Unless otherwise indicated compressed air system shall be of "instrument" quality, as further modified by other requirements stated herein. *Uses requiring "Process" quality air require further development of project-specific criteria.*
- h. Compressed air system shall have redundant P3 filtration followed by redundant coalescing air filtration
- i. Compressed air dew point shall be reduced to 40 degrees Fahrenheit
- j. Provide a certificate issued by an appointed examiner or recognized inspection body in respect of the air receiver certifying the inspection during construction of the air receiver, and its auxiliary equipment.

22.18. Laboratory Gases

- a. Piped gas systems shall be thoroughly identified and coded and all fuel gas pipe downstream of the meter shall be above grade.
- b. Natural gas outlets shall not be installed in bio-safety cabinets or other contained rooms or areas that are not fully exhausted.
- c. Natural gas shut-off valves shall be provided at the entrance to the room in which the gas is being used.
- d. All medical gas outlets shall be D.I.S.S. type. All piping, tubing and fittings shall be pre-cleaned. Copper shall be type K.
- e. Vacuum pumps shall be CLAW, oil lubricated or dry rotary vane type; liquid ring vacuum pumps shall not be used.
- f. Drain and waste lines shall be selected for chemical resistance **and** heat resistance where steam is used as a laboratory medium.

22.19. Backflow Preventers

- a. Comply with requirements of the City of Norfolk or other water supply authority requirements.
- b. Backflow Preventers (BFP's) shall be mounted approximately 3'-4' above the floor and be readily accessible for maintenance and located inside a heated building.
- c. BFP's shall be of the reduced pressure zone (RPZ) type. The assembly shall include shut off valves on inlet and outlet, and strainer on inlet "Y" strainer. Backflow preventers shall include test cocks and pressure-differential relief valve located between two (2) positive seating check valves.
- d. Seats and seat discs shall be replaceable in both check modules and the relief valve.
- e. Valve body and check modules shall be brass.
- f. There shall be no threads or screws in the waterway exposed to line fluids.
- g. Service of all internal components shall be through a single access cover secured with stainless steel bolts.
- h. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting.
- i. Provide access for backflow preventers that are installed in obscure places to allow removal of the entire unit for service/replacement.
- j. Floor drain pipe size to be determined /evaluated before installation of backflow preventer to ensure that floor drain is capable of handling backflow to prevent flooding.
- k. Consideration of where the back flow preventer water will flow during testing is key. Concerns are for the water pressure to disturb landscape materials, rocks, paver systems sand and gravel infill, etc. due to the force of the stream. Consider including splash blocks or other design features to avoid the destruction of the site where the water daylights.

22.20. Refer to **CHAPTER ONE – PROJECT GENERAL REQUIREMENTS** for close out procedures.

22.21. Plumbing Piping and Fittings

- a. See Chart next page

System	Piping Material	Fitting Material
AC Condensate	Type L Copper or PVC Sch. 40	Copper or Solvent weld PVC
<u>Domestic Water</u> Under-building-slab NPS 3 and smaller	Hard copper tube, Type L, ASTM B 88	Wrought-copper, solder-joint fittings; and brazed joints.
<u>Domestic Water</u> Under-building-slab NPS 4 to NPS 8 and larger	Ductile-iron pipe; standard-pattern	Mechanical-joint fittings; and mechanical joints. Push-on-joint fittings; and gasketed joints.
<u>Domestic Water</u> Underground 2" and Smaller:	Soft copper tube, Type K, ASTM B 88	Copper pressure fittings; and soldered joints with no joints permitted below concrete slabs, PEX-a (Engle-Method Crosslinked Polyethylene) Piping and engineered polymer (EP) or lead-free brass F1960 cold expansion fittings with no joints permitted below concrete slabs.
<u>Domestic Water</u> Underground 2-1/2" and above	Soft copper tube, Type K, ASTM B 88	Copper pressure fittings; and soldered joints.
<u>Domestic Water</u> Aboveground NPS 2 and smaller	Hard copper tube, Type L, ASTM B 88	Wrought-copper, solder-joint fittings; and soldered joints. OR Type L copper pressure fittings; and soldered joints.
<u>Domestic Water</u> Aboveground NPS 2	Hard copper tube, Type L, ASTM B 88 OR Hard copper tube, Type L with grooved ends	Copper pressure fittings; and soldered joints or hard copper tube, Type L with grooved ends; copper grooved-end fittings; copper-tubing, keyed couplings; and grooved joints.
<u>Domestic Water</u> Aboveground NPS 2-1/2 to NPS 4	Hard copper tube, Type L, ASTM B 88 OR Hard copper tube, Type L with grooved ends	Copper wrought-copper, solder-joint fittings; and soldered joints. OR Copper grooved-end fittings; copper-tubing, keyed couplings; and grooved joints.
<u>Sanitary Soil & Waste</u> Aboveground NPS 4 and smaller	Hubless, cast-iron soil pipe and fittings OR Solid-wall PVC pipe, ASTM D 2665	CISPI hubless-piping couplings; and coupled joints. ASTM C 1277 and CISPI 310 OR PVC socket fittings, and solvent-cemented joints.
<u>Sanitary Soil & Waste</u> Aboveground NPS 5 and larger	Hubless, cast-iron soil pipe and fittings	CISPI hubless-piping couplings; and coupled joints. ASTM C 1277 and CISPI 310
<u>Sanitary Waste</u> Aboveground Indirect sanitary piping	Copper DWV tube	Copper drainage fittings, and solder joints.
<u>Sanitary Soil, Waste & Vent</u> Aboveground located inside plenum	Hub-less cast-iron soil piping	Heavy duty couplings
<u>Sanitary Soil, Waste & Vent</u> Underground NPS 4 and smaller	Solid wall PVC pipe, ASTM D 2665	PVC socket fittings, and solvent-cemented joints.

System	Piping Material	Fitting Material
<u>Sanitary Soil & Waste</u> Underground NPS 5 and larger	Solid-wall PVC pipe, ASTM D 2665	PVC socket fittings; and solvent-cemented joints. ASTM D 2665, made to ASTM D 3311 and to fit Schedule 40 pipe.
<u>Sanitary Soil & Waste</u> Underground Kitchen Waste	Extra Heavy Hub and Spigot cast-iron soil piping	Cast Iron fittings
<u>Sanitary Soil & Waste</u> Underground Other than kitchen waste:	Service Weight Hub and Spigot cast iron soil pipe	Cast Iron fittings
<u>Storm Drainage</u> Aboveground NPS 6 and smaller	Hubless, cast-iron soil pipe and fittings OR Copper DWV tube	Heavy-duty CISPI hubless-piping couplings; and coupled joints OR Copper drainage fittings, and soldered joints.
<u>Storm Drainage</u> Aboveground NPS 8 and larger	Hubless, cast-iron soil pipe and fittings	Heavy-duty CISPI hubless-piping couplings; and coupled joints.
<u>Storm Drainage</u> Underground NPS 6 and smaller	Hubless, cast-iron soil pipe and fittings OR Solid-wall PVC pipe,	CISPI hubless-piping couplings; and coupled joints. OR PVC socket fittings, and solvent-cemented joints.
<u>Storm Drainage</u> Underground NPS 8 and larger	Hubless, cast-iron soil pipe and fittings; OR Solid-wall PVC pipe,	Heavy-duty CISPI hubless-piping couplings; and coupled joints. OR PVC socket fittings, and solvent-cemented joints.
<u>General Service Compressed Air Piping</u> Low-Pressure Compressed-Air Distribution Piping NPS 2 and Smaller	Schedule 40, black steel pipe	Threaded, malleable-iron fittings; and threaded joints.
<u>General Service Compressed Air Piping</u> Drain Piping NPS 2 and Smaller	Hard copper tube, Type L	Wrought-copper fittings; and brazed or soldered joints.
<u>Hydronic Piping</u> Aboveground Hot-water heating piping NPS 2 and smaller	Type L, drawn-temper copper tubing	Wrought-copper fittings, and soldered or brazed joints.
<u>Hydronic Piping</u> Aboveground Hot-water heating piping NPS 2-1/2 and larger	Schedule 40 steel pipe	Wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
<u>Hydronic Piping</u> Aboveground Chilled-water piping NPS 2 and smaller	Type L, drawn-temper copper tubing	Wrought-copper fittings, and soldered or brazed joints.
<u>Hydronic Piping</u> Aboveground Chilled-water piping NPS 2-1/2 and larger	Schedule 40 steel pipe	Wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints
<u>Hydronic Piping</u> Aboveground Condenser-water piping NPS 2 and smaller	Type L, drawn-temper copper tubing	Wrought-copper fittings, and soldered or brazed joints.

System	Piping Material	Fitting Material
<u>Hydronic Piping</u> Aboveground Condenser-water piping NPS 2-1/2 and larger	Schedule 40 steel pipe	Wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
<u>Hydronic Piping</u> Aboveground Makeup-water piping	Type L, drawn-temper copper tubing	Wrought-copper fittings, and soldered or brazed joints.
<u>Hydronic Piping</u> Condensate-Drain Piping	Type DWV drawn-temper copper tubing	Wrought-copper fittings, and soldered joints.
<u>Hydronic Piping</u> Blowdown-Drain Piping	Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.	
<u>Hydronic Piping</u> Air-Vent Piping	Inlet: Same as service where installed Outlet: Type K, annealed-temper copper tubing	Inlet: metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions. Outlet: soldered or flared joints
<u>Hydronic Piping</u> Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping	Same materials and joining methods as for piping specified for the service in which safety valve is installed	Metal-to plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

<u>Refrigerant Piping</u>	Copper Tube ASTM B 280, Type ACR	Wrought-copper fittings ASME B16.22
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<u>Facility-Natural Gas Piping</u> Aboveground Exposed Fuel Gas Piping AND Concealed Fuel Gas Piping System Pressure less than 0.5 psig branch piping NPS 1 1/2 and smaller	Schedule 40 Steel pipe Type E or S, ASTM A3 /A53M	malleable-iron threaded fittings, and threaded joints
<u>Facility-Natural Gas Piping</u> Aboveground Exposed Fuel Gas Piping AND Concealed Fuel Gas Piping NPS 2 to NPS 4	Schedule 40 Steel pipe Type E or S, ASTM A3 /A53M	Malleable-iron threaded fittings, and threaded joints, OR Steel pipe, steel welding fittings, and welded joints.
<u>Facility-Natural Gas Piping</u> Aboveground Exposed Fuel Gas Piping AND Concealed Fuel Gas Piping Larger Than NPS 4 System Pressure less than 0.5 psig AND System Pressures more than 0.5 psig and less than 5 psig	Schedule 40 Steel pipe Type E or S, ASTM A3 /A53M	Steel welding fittings, and welded joints
<u>Facility-Natural Gas Piping</u> Under Slab Fuel Gas Piping: (NOTICE: Method of fuel gas piping installation below floor slab must be approved by the authority having jurisdiction.)	Pre-Sleeved Corrugated, Stainless-Steel Tubing Systems.	Steel pipe, steel welding fittings, and welded joints with welded steel vented conduit.

System	Piping Material	Fitting Material
<u>Storm Drainage</u> Aboveground Service class 2" and Larger	Cast-iron soil piping	Gaskets; and gasketed joints.
<u>Storm Drainage</u> Aboveground Hubless 2" and larger	Cast-iron soil piping	Couplings: a. Heavy-duty, Type 304, stainless steel. b. Heavy-duty, cast iron.
<u>Storm Drainage</u> Underground 2" to 4": Service class	cast-iron soil piping	Gaskets; and gasketed joints.
<u>Storm Drainage</u> Underground 2"	Schedule 40 PVC pipe	PVC socket fittings, and solvent-cemented joints
<u>Storm Drainage</u> Underground NPS 2 and larger Hubless	cast-iron soil piping	Couplings a. Heavy-duty, Type 304, stainless steel. b. Heavy-duty, cast iron.
<u>Storm Drainage</u> Underground NPS 8 and Larger Service class	cast-iron soil piping	Gaskets; and gasketed joints.
<u>Acid Resistant Waste & Vent</u> Aboveground	flame-retardant schedule 40 polypropylene	Socket fusion fittings. Mechanical joints allowed only under lab benches inside accessible cabinets and not in cabinet pipe chase.
<u>Acid Resistant Waste & Vent</u> Belowground	Schedule 80 polypropylene	Socket fusion fittings