DESIGN GUIDELINE 221113
BASIC PIPING MATERIALS AND METHODS

General

In general, follow the guidelines below when designing and specifying pipe, pipe fittings, and accessories. Unless specifically indicated otherwise, these guidelines are not intended to restrict or replace professional judgment. Piping materials shall be compatible with systems served.

Related Sections

U-M Design Guideline Sections:
Division 2 - Sitework
210000 - Fire Protection
220020 - High Purity Water Systems
220719 - Mechanical Insulation
SBA 5.9 -Tunnels

U-M Master Specification Sections:
Division 2 - Sitework
211313 - Wet Pipe Sprinkler Systems
221113 - Basic Piping Materials and Methods
232116 - Hydronic Piping Specialties
232216 - Steam and Condensate Piping Specialties
232300 - Refrigerant Piping

Ductile Iron Pressure Pipe Inside Buildings

In all cases, ductile iron pressure pipe running inside buildings shall be equipped with retrained joints. This includes new construction and renovation work.

Ductile iron pressure pipe should normally not be run inside buildings. A typical case when this is unavoidable is underground domestic, fire protection, or chilled water ductile iron pipe connecting to the associated building piping system. The transition between the underground ductile iron pressure pipe and the building pipe shall be accomplished with a flange located inside the building.

- For new installations, specify that the termination of the ductile iron pipe (and any ductile iron joint inside the building) be factory threaded and equipped with a screw-on, machine tightened, ductile iron flange that complies with ANSI/AWWA C110 and C115, similar to that available from American Ductile Iron Pipe, US Pipe, and others.

For existing buildings with unrestrained plain end or mechanical joint ductile iron piping, replace with restrained flange adapters with actuating screws that break off when tightened to

the proper torque, such as EBAA Iron Incorporated MEGAFLANGE Series 2100. Do not specify restrained flange adapters that do not incorporate break-off actuating screws.

General Material Requirements

Refer to U-M Master Specification for piping and accessory materials and installation requirements, including: Drainage and Vent Piping, Pressurized Plumbing Piping, Hydronic and Steam Piping, Eccentric Fittings, Tees in Welded Pipe, Solder in Copper Piping Joints, Dielectric Protection, Flanges, and Unions – previously addressed in this section. In all cases, pipe materials and accessories must be compatible with systems served (pressure, temperature, corrosion resistance). Master specifications contain extensive hidden text for the specification editor to guide decision making process. Where U-M Master Specifications are used, edit and customize on a project specific basis. Note that only the more typical piping applications are covered in the U-M master specification; assure every pipe application specific to the project is specified. Additional clarification is included in paragraphs that follow.

Mechanical Piping Material Requirements

Refer to U-M Master Specification Sections for details of piping material requirements. Clarifications and exceptions are noted below.

Domestic Cold Water and Hot Water

Domestic Hot Water piping installed in the central campus tunnel system shall use exclusively Victaulic grooved copper pipe and fittings.

Storm and Sanitary Waste and Vent Piping

Vent piping shall be the same as waste piping.

Master specification includes both cast iron and PVC piping. Use cast iron unless specifically instructed by U-M Design Manager to use PVC. While PVC may have some appropriate applications in small projects, there can be smoke/fire related problems with using PVC.

Laboratory Waste and Vent Piping

For most chemistry and biology labs, dumping of acids and other corrosive chemicals is prohibited. As such the waste stream is generally dilute, within Ph limits suitable for discharge to city sanitary sewers. Therefore, in most cases, neutralization pits are not required. Confirm design philosophy on lab waste system with U-M Design Manager.

For general lab applications, above ground lab waste piping is typically specified as corrosion resistant polypropylene, Schedule 40. Joints may be mechanical type or fuse-sealed, depending on application. For new lab buildings, or renovations with extensive new drainage networks, fused joints should normally be specified. Consult U-M Design Manager. Fused joints are generally less prone to developing leaks, but may be more expensive. All sink P-traps shall be of the same material as the waste pipe, and include mechanical fittings for ease of maintenance.

Underground piping shall be polypropylene, Schedule 80. Joints shall be fused type. Consult U-M Design Manager. Double walled underground piping is not generally required.

Alternate piping material shall be considered on a case-by-case basis where high temperature waste or other factors may be present. High silicon cast iron may be considered if the application warrants the added expense. Glass piping may be considered where high temperature waste is present.

High Purity Water Piping

Design piping system to meet project specific requirements. Some applications can use PVC piping (humidifiers), while others require polypropylene (most labs). Consult U-M Design Guideline 220020 – High Purity Water Systems for detailed requirements.

Vacuum Piping

Provide a plugged cross at all turns greater than 45 degrees, slope in the direction of flow and provide hose end drain valves at all low points for cleaning the system.

Chilled Water Piping

Large underground piping should generally be uninsulated ductile iron (Class 52 with Polyethylene wrap). For small piping, consider alternate materials and need for insulation.

Hot Water Heating Piping

Underground piping shall be installed using a preinsulated piping system. Carrier pipe shall match above ground piping. Jacket pipe shall be minimum 10 gauge steel, with butt welded fittings, and a fiberglass reinforced urethane elastomeric coating. Refer to section 220719 for insulation requirements.

(Steam) Condensate Piping

Underground condensate (from steam) piping shall be schedule 80 black steel with extra heavy fittings in a preinsulated system as described for underground hot water heating piping. Condensate piping shall not be run in common jacket pipe with other carrier pipes, unless specifically approved by U-M Design Manager and Utilities Department. Generally, two underground condensate lines are installed – one spare for future use.

Condenser Water Piping

U-M is presently considering non-ferrous (stainless steel, fiberglass, ABS) piping alternatives for improved water quality. Preliminary analysis indicates that non-ferrous piping may be justifiable, especially in applications where the cooling tower is drained seasonally, and where piping is not heat traced and insulated. Schedule 10 stainless steel condenser water piping has been used on some projects. Consult U-M Design Manager.

Underground condenser water piping shall be ductile iron.

Steam Piping

Underground steam piping up to 125 psig shall be Schedule 40 black steel with butt welded fittings, in a pre-insulated system as described for underground hot water heating piping.

Civil Pipe Material Requirements

Generally, underground piping 5 feet or more from building exterior walls is considered to be "Civil Piping". The following piping materials apply to Civil piping only, and may indicate that a change in pipe material takes place at this point. Refer to Tab 2 - Sitework for additional requirements.

Storm Sewer

Shall be reinforced concrete pipe (RCP), ASTM C-76, Class IV, with rubber gasketed joints, ASTM C-443, or High Density Polyethylene with rubber gasketed joints. For small projects with piping limited to 6" and 8", Schedule 80 PVC pipe may be used.

Sanitary Sewer

Shall be extra strength vitrified clay pipe (VCP) with O-ring joints. Sewers 15" and larger shall be reinforced concrete pipe (RCP), ASTM C-76, Class IV, with rubber gasketed joints, ASTM C-443

City Water Mains (for domestic water and fire protection)

Shall be Ductile Iron Class 52 with Polyethylene wrap.

Under Drainage Tubing

Shall be corrugated polyethylene tubing (AASHTO M 252) or corrugated polyvinylchloride tubing (ASTM F 800, with holes conforming to (AASHTO M 252)

Lawn Sprinkler Piping

Coordinate irrigation system design (including sizing water main, backflow preventer, and water meter) and installation with the University Landscape Architects Office and the U-M Plumbing shop, via the U-M Design Manager.

Pipe Hangers and Supports

Refer to U-M Standard Details, U-M Master Specification 230000 for additional hanger and support requirements previously addressed in Design Guideline Section 221113. Refer to Design Guideline Section 230000 for building attachment requirements previously included in this section.

Prior to beginning design, A/E shall review building design and construction and design suitable building attachment and pipe support and anchoring system, verifying that the existing building structure can support new piping loads.

The A/E shall include the following in piping designs:

- Pipe hanger details, including components, hanger spacing.
- Pipe hanger systems that accounts for thermal expansion of piping.
- Details of building attachments, including clarifying when support of piping from concrete slab using expansion anchors is acceptable. "C" type clamp hangers are acceptable for fire protection piping and all piping 2" and smaller when retaining clips are used.
- For large piping or where the design otherwise impacts the integrity of the building structure, indicate locations of all pipe hangers.
- For existing buildings with concrete floors, determine the extent to which vertical drill-in or similar type inserts can be used, and delineate any limitations regarding their use in the specifications. Many older buildings may not have sufficient floor thickness or integrity to allow the use of such inserts.
- Indicate locations and details of pipe anchors, guides and expansion joints or bends.

A/E shall include the following in the Project OPR/BOD document:

- Pipe expansion and stress calculations for hot pipes (120°F and above), 6" and larger. Show compliance with ANSI piping codes.

Large piping and equipment shall be independently supported from building structure, not from roof decks, etc. All piping shall be directly supported from the building, not from other piping, ductwork or equipment.

Dissimilar metal-to-metal contact between pipe and hanger is prohibited. Specify isolators, such as plastic coated hangers for copper pipe, to avoid dissimilar metal-to-metal contact between pipe and hanger.

Hangers for piping that lacks rigidity, such as polypropylene pipe, shall be spaced, as a minimum, as recommended by the manufacturer or preferably, with a continuous support. Since the spacing is typically much closer than for other piping materials, the designer must pay close attention to the implications on the design.

For cold piping systems, design piping hangers to retain integrity of vapor barriers. Specify cal-sil or similar pre-formed inserts and insulation shields for all piping 4" to 12" requiring a vapor barrier (wood blocking is not acceptable). Insulation shields are acceptable for piping 3" and below.

Design for Thermal Expansion:

Account for thermal expansion when designing pipe hangers and supports. Where space allows, expansion bends fabricated from standard piping are preferred over expansion joints.

For Expansion Design Requirements for steam in tunnels, see U-M Design Guideline SBA-H.

For steam tunnels, on low pressure steam (LPS), externally pressurized bellows type expansion joint shall be used. For low pressure condensate (LPC), use externally pressurized bellows type expansion joint or equal expansion bellows type expansion joint. For domestic hot water

(DHW), use equal expansion type bellows joints with all Stainless steel construction (no carbon steel on wetted parts). Refer to U-M Master Specification 220516 – Pipe Expansion Joints.

Pipe Hanger Submittals

A/E shall require that the Contractor submit the following for A/E review and approval:

- Type and model for all manufactured pipe support components, including building attachments, hangers, insulation saddles and shields, expansion joints, anchors.
- Locations of anchors, expansion bends and joints.
- Locations of building attachments where deemed necessary by A/E.
- Details and supporting calculation of additional supports.

A/E shall review contractor's hanger support shop drawings and details to verify that unacceptable pipe movement during all phases of operation of the system (start-up, sudden gpm changes, or shutdown) will not occur.

Pipe Hanger Shields and Preinsulated Pipe Supports

Pipe shields and preinsulated pipe supports shall be used to protect piping insulation and vapor barrier (for cold piping) as described below.

- Horizontal Cold Piping (CHWS/R, CW) sizes 2" and less:
  Provide galvanized insulation protection shields under 180 degrees of piping, between hangers and pipe insulation.
- Horizontal Cold Piping (CHWS/R, CW) sizes 2 1/2 and over:
  Provide 360 degree preinsulated welded pipe shields between piping and hanger.
- For all Cold Piping Vertical Risers:
  Provide preinsulated riser clamps.
- For Hot Piping:
  Account for thermal expansion when designing pipe supports and shields. Where suitable install hangers directly on the pipe and bury hanger in insulation. Where necessary, install pipe saddle on pipe, preinsulated pipe shield or galvanized insulation protection shield.

Pipe Penetrations and Sleeves

Provide pipe sleeves where required, including the following locations:

- Where required by code
- Where required as part of rated penetration, to maintain fire and smoke rating
- To support vertical piping (to support riser clamps).
- Where required to maintain water seal and prevent water penetration.
- Where pipe movement is anticipated (especially due to thermal expansion) at the penetration.

Fire Protection Piping, Compressed Air and other uninsulated piping: Sleeves are generally not required, unless required to maintain integrity of rated walls.

Chilled Water and Cold Water: Sleeves are generally required for all piping 2" and larger penetrating walls and floors.

Steam, Condensate, Heating Hot Water, and other hot insulated piping: Sleeves are required for all piping in walls and floors.

For underground exterior wall penetrations, piping penetrations must be watertight. For new construction, provide cast-in-place pipe sleeve with integral water-stop, oversized for use of linkseal between piping and sleeve. In existing concrete, where concrete can be core drilled and properly sealed with a linkseal, a sleeve may not be required.

For renovation work with existing concrete floors or for new floors where cast-in-place sleeves were not installed, pipes penetrating above grade floors typically require "double core" sleeves, especially in areas where floors are likely to get wet, and where water leaks to floors below would be disruptive to operations. Piping in stairwells does not require floor sleeves.

Include appropriate, project specific penetration and sleeve details for all conditions. Refer to U-M details, and customize as required.

Pipe Pressure Testing Requirements

Include pressure testing requirements in the project specifications or on the project drawings. U-M Standard Detail 221113 – Basic Piping Materials and Methods indicates typical pressure testing requirements and may be used provided it is revised to reflect project specific requirements.

For each system pressure tested, require that a test report be provided using owner furnished forms, certifying that the system was satisfactorily tested and passed.

Flushing and Cleaning of Piping Systems

At minimum, the A/E shall include the flushing and cleaning requirements found in Part 3 of U-M Master Specification 221113 – Basic Piping Materials and Methods. Refer to the spec. editors notes in U-M Master Specification 221113 for additional information.

Dye Testing Requirements for Storm and Sanitary Piping

Dye testing is required on most new connections to new and existing storm and sanitary waste piping. Refer to Master Specification Section 221113 (including hidden notes) and OSEH Dye Testing Guidelines for Storm Water & Sanitary Systems.

Where practical, dye testing of underground piping should be done during design phase to validate that the design is in compliance with effluent discharge codes and regulatory requirements. Special attention should be paid to mechanical room floor drains and cooling

tower overflow drains, both of which are now required to be routed to sanitary waste. Testing may also require services of the U-M Plumbing Shop. Coordinate with U-M Design Manager.

Require construction phase dye testing by the contractor, after final connection is made, and before system is put into service. See the U-M Master Specification Section 221113 for additional guidance. To facilitate efficient and effective testing, indicate location of appropriate validation points on plans. This is typically the first manhole outside the building.