

Division 22 | Plumbing

This section includes guidelines and requirements for the design and construction of plumbing systems, equipment, materials, and other items covered in Division 22. Unless specifically noted, all standards apply to both the healthcare campus and the education campus.

The standards are a resource for the designer of record. The requirements are to be reviewed by the design team and incorporated into the contract documents. The standards themselves will not be included in the contract documents. It is the responsibility of the design team to incorporate them throughout the drawings and specifications.

The standard is not intended to encompass all components required in a complete plumbing design, but to indicate the university's preferences where they exist. Exceptions to these standards may be considered on a case-by-case basis for extraordinary projects or where value engineering is required. All deviations must be approved by the Capital Projects Project Manager.

Designers are encouraged to present the university with new or different systems, equipment, or materials when they may provide a better or more valuable product.

This standard supersedes any older plumbing standards which may remain posted in Division 22 or divisions on CPMD's standards pages.

Sections

[Section 22 0516 | Piping Expansion Joints](#)

[Section 22 0523 | Valves for Plumbing Piping](#)

[Section 22 0523 | Identification for Plumbing Piping and Equipment](#)

[Section 22 0719 | Plumbing Piping Insulation](#)

[Section 22 1116 | Domestic Water Piping](#)

[Section 22 1119 | Domestic Water Piping Specialties](#)

[Section 22 1316 | Sanitary Waste and Vent Piping](#)

[Section 22 3300 | Domestic Water Heaters](#)

[Section 22 4213 | Commercial Plumbing Fixtures](#)

[Section 22 4500 | Emergency Plumbing Fixtures](#)

[Section 22 6600 | Chemical-Waste Systems for Laboratory and Healthcare Facilities](#)

[Section 22 6719 | Processed Water Equipment for Laboratory and Healthcare Facilities](#)

Section 22 0516 | Piping Expansion Joints

1. PHYSICAL REQUIREMENTS

- A. All expansion joints shall be metal expansion joints consisting of a single hydraulically formed metal bellows with flange end fittings. Flanges shall be 150 lb. carbon steel and bellows shall be 304 or 316 stainless steel. All wetted surfaces shall be stainless steel.
- B. Joints shall be designed to meet the design pressures and temperature for the system and shall be capable of accommodating piping system and equipment movements as needed. Pressure rating minimums shall be:
 - 1. 150°F Maximum Working Pressure: 225 psi
 - 2. 212°F Maximum Working Pressure: 190 psi
 - 3. 480°F Maximum Working Pressure: 110 psi
- C. Tie rods shall be included to prevent overextension of the expansion joints from pressure thrust loads. The number and size of the control rods shall be sufficient for the maximum system test pressure.
- D. Rubber expansion joints are not acceptable in any of these applications.

Section 22 0523 | Valves for Plumbing Piping

1. GENERAL REQUIREMENTS

- A. Isolation valves are to be installed on domestic water systems on all mains, all floor take-offs of mains, and take-offs of branch lines where multiple devices are fed by that take-off.
- B. Valves on the domestic hot and cold systems shall be 150 lb. valves.
- C. Bronze ball valves are to be used on all pipes sized 2 ½" and smaller. The ball valves are to be threaded type and not soldered.
- D. Butterfly valves are to be used on all pipes larger than 2 ½". Ductile iron body, stainless steel stem and disc. Provide high-performance butterfly valves on the medical campus.
- E. All lavatories or sinks are to have stop valves installed under the unit for the isolation of the device. The stop valves are to be threaded on the inlet side of the valve with threaded or compression connections on the outlet side. Compression connections are not allowed on the inlet side of the stop valves.
- F. Plastic parts are not allowed on any domestic water valve.
- G. Shark Bite or similar valves are not allowed – even on a temporary basis.
- H. Check valves are to be provided at all connections where cross-over may be an issue – single opening fixtures, mop sinks, etc.

Section 22 0523 | Identification for Plumbing Piping and Equipment

1. PIPE LABELING

- A. All plumbing piping is to be labeled – every 15 feet above ceiling, every 10 feet in an open mechanical room, and at least once in every room.
- B. Labels are to be preprinted, color-coded, with lettering indicating service and showing flow direction.
 - 1. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to cover the full circumference of pipe and to attach to pipe without fasteners or adhesives.
 - 2. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent adhesive backing
- C. Lettering size: Minimum 1-1/2 inches high.
- D. Label colors shall be per the University of Kentucky Standard Color Coding for Plumbing Piping schedule at the end of this section.

2. EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

3. CEILING LABELS

- A. Attach seton-ply discs to the ceiling grid under equipment or valves.
- B. Label discs according to the following schedule:

Equipment	Color	Engraving
Valve	Yellow	V.

4. VALVE TAGS

- A. Stamped or engraved 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or S-hook. Wire shall not be used as a method for connecting the tags to the valve. The tags shall be installed after insulation has been installed.
- B. Valve Schedule: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shut-off and similar special uses.
1. Valve tag schedule shall be included in the operation and maintenance data.
5. PAINTING
- A. All plumbing piping in mechanical rooms shall be painted once insulation is complete.
 - B. Paint colors shall be per the University of Kentucky Standard Color Coding for Plumbing Piping Chart at the end of this section.

6. UNIVERSITY OF KENTUCKY STANDARD COLOR CODING FOR PLUMBING PIPING

Type of Service	Markings	Color*	No.*
Domestic cold water	D.C.W.	Safety Green	SW4085
Domestic hot water	D.H.W.	Green Byte	SW4076
Natural gas	GAS	Deck Red	SW4040
Sanitary Waste	SAN	None	--
Vent	V	None	--
Acid waste & vent systems	AWV	None	--
Air (steel pipe)	AIR	Galvano	SW4027
Air (copper pipe)	AIR	None	--
Vacuum (copper pipe)	VAC	None	--
Vacuum (steel pipe)	VAC	Galvano	SW4027
Roof leaders	R.L.	Galvano	SW4027
Soft water	S.W.	Pillar White	SW4029
De-mineralized water	D.W.	None	--
Distilled water	DIST. W.	None	--
Diesel fuel	D. FUEL	Galvano	SW4027
Nitrogen	NITROGEN	Galvano	SW4027
Elevator oil lines	E.O.L.	Galvano	SW4027
Muratic acid	MUR. ACID	Galvano	SW4027
Sulfuric acid	SUL. ACID	Galvano	SW4027
Gasoline	GASOLINE	Galvano	SW4027
Nitrous oxide (copper)	N. OXIDE	None	--
Caustic soda	C. SODA	Galvano	SW4027
Sump pump discharge	S. PUMP DIS.	Galvano	SW4027
Oxygen	OXYGEN	None	--
Ammonia	AMMONIA	Bolt brown	SW4001
Non-Potable Water	NPW	Safety	SW4080

*Color and number are from Sherwin Williams System 4000 color selection guide dated 1999

Section 22 0719 | Plumbing Piping Insulation

1. FIBERGLASS INSULATION APPLICATION AND THICKNESS

Pipe System	Temp. Range	1"	1-1/4" – 2"	2-1/2" – 3"	4" – 6"	8" – 10"	12" and Up
Domestic Hot	120 – 180	1"	1"	1-1/2"	2"	2"	2"
Domestic Cold	55 – 70	1/2"	1"	1"	1"	1"	1"
Horizontal Roof Leaders	<55	1/2"	1/2"	1/2"	1"	1"	1"

- A. Equivalent thickness of closed cell foam insulation may be used on pipes 1" diameter or less. Provide Armacell closed cell polyethylene or approved equal. Product must meet all current specification compliance i.e. ASTM, UL NFPA and UL. Where possible, insulation tubes are to be slipped over the carrier pipe (not slit). With split tubes, all joints and seams are to be wrapped with Black LapSeal for protection against condensation, mold, and energy loss. Any outdoor use must be UV protected with WB Finish or other protective jacketing to prevent damage from UV or physical damage and comply with the energy protection sections of the IECC and ASHRAE. Use in steam vaults is prohibited.
- B. Exposed piping in any room and all piping in mechanical rooms shall have an 8-ounce canvas jacket applied over the fiberglass factory ASJ/SSL jacketing to further protect the insulation from abuse.
- C. This jacketing must be properly applied with lagging adhesive, such that the outer surface is smooth and free of wrinkles.
- D. The canvas jacketing in all mechanical areas is to be prepared for painting, and then painted according to the University of Kentucky standard piping color coding.
- E. For all systems except steam, plenum rated PVC jacket equal to LoSmoke PVC jacket with flame/smoke rating of 25/50, ASTM-E84 test method. Minimum thickness 0.04 inches. Steam systems shall utilize plenum rated CPVC jacket with minimum thickness of 0.04 inches. Jackets shall be applied over top of specified pipe insulation. Approved equal manufacturers are Zeston and Speedline. Approved equal manufacturers are Zeston and Speedline.

Section 22 1116 | Domestic Water Piping

1. PIPE AND FITTING SCHEDULE – MEDICAL CAMPUS

	Service	Size	Piping	Fittings
1	Domestic Cold Water, Underground	All sizes	Type K Hard Copper*	Wrought copper lead-free solder
2	Domestic Hot and Cold Water	Less than 2"	Type L Hard Copper	Wrought copper lead-free solder
3	Domestic Hot and Cold Water	2" – 4"	Type L Hard Copper	Brazed or grooved
4	Domestic Hot and Cold Water	5" and Larger	Type L Hard Copper or Schedule 10 Stainless Steel	Brazed, Welded, or grooved fittings

*Soft copper allowed to trap primer connections under building slabs.

2. PIPE AND FITTING SCHEDULE – EDUCATION CAMPUS

	Service	Size	Piping	Fittings
1	Domestic Cold Water, Underground	All sizes	Type K Hard Copper*	Wrought copper lead-free solder
2	Domestic Hot and Cold Water	2" and Less	Type L Hard Copper	Wrought copper lead-free solder or press fittings**
3	Domestic Hot and Cold Water	2" – 4"	Type L Hard Copper	Solder or grooved**
4	Domestic Hot and Cold Water	5" and Larger	Type L Hard Copper or Schedule 10 Stainless Steel	Solder, Welded, or grooved fittings**

*Soft copper allowed to trap primer connections under building slabs.

**Grooved and press fittings are only allowed in accessible locations. Not allowed inside walls, shafts, or above drywall ceilings.

3. Press Fitting Requirements

- A. All fittings on a project must be of a single manufacturer.
- B. Manufacturer shall train and certify all installers on installation of press fittings.
- C. Manufacturer shall make periodic site visits to ensure quality of installation.
- D. Fittings shall conform to ASTM F3226, NSF 61, and NSF 372
- E. Fittings shall have a leak detection feature integral to the fitting body to detect unpressed fittings during testing process. Contractors shall follow the manufacturer's specific testing requirements.

4. Grooved Fitting Requirements

- A. All fittings on a project must be of a single manufacturer.
- B. Manufacturer shall train and certify all installers on installation of grooved fittings.
- C. Manufacturer shall make periodic site visits to ensure quality of installation.
- D. Roll grooving is preferred to cut grooving.
- E. Strapless branch outlets are prohibited.
- F. Acceptable Manufacturers – Medical Campus
 1. Victaulic
- G. Acceptable Manufacturers – Education Campus
 1. Victaulic
 2. Gruvlok

Section 22 1116 | Domestic Water Piping Specialties

1. WATER HAMMER ARRESTORS

- A. Water hammer arrestors shall be maintenance-free, permanently sealed, piston-style.

Section 22 1316 | Sanitary Waste and Vent Piping

1. PIPING

- A. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute® and listed by NSF® International. Hubless Couplings shall conform to CISPI Standard 310 and be certified by NSF® International. All couplings shall be Heavy Duty couplings shall conform to ASTM C 1540 and shall be used on all projects. Gaskets shall conform to ASTM C 564. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and applicable code requirements. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque recommendations. Tighten bands with a properly calibrated torque limiting device. The system shall be hydrostatically tested after installation to 10 ft. of head (4.3 psi maximum).

2. PIPING SCHEDULE

	Service	Sizes	Pipe	Fittings
1	Sanitary Waste and Vent Piping, Aboveground	1-1/2" – 4"	Hubless cast iron soil pipe	4 clamps per coupling
2	Sanitary Waste and Vent Piping, Aboveground (Option)	1-1/2" – 4"	Copper Type DWV tube	Copper drainage fittings and soldered joints
3	Sanitary Waste and Vent Piping, Aboveground	5" – 10"	Hubless cast iron soil pipe	6 clamps per coupling
4	Sanitary Waste and Vent Piping, Aboveground (Alternate*)	All Sizes	Schedule 40 PVC (White)	
5	Sanitary Waste and Vent Piping, Underground	2" and Larger	Service weight hub & spigot cast iron pipe	Gasketed joints

*Alternate must be approved by CPM Project Manager

- A. PVC should not be considered where drains serve mechanical rooms, kitchens, sterilizer rooms, or similar.

Section 22 3300 | Domestic Water Heaters

1. GENERAL REQUIREMENTS FOR ALL PROJECTS

- A. All hot water systems are to be recirculated to assure hot water readily available at point of use.
- B. Hot water to building occupants should be delivered at 120°F.
- C. Engineer shall evaluate other pieces of equipment which may require different temperature hot water.
- D. Soft water should be considered for any new dishwashing equipment.

2. HOT WATER MONITORING ON MEDICAL CAMPUS

- A. Each floor or loop of the hot water system shall be monitored by the BAS system; both the supply and return. Provide a thermometer adjacent to each temperature sensor.

Section 22 4213 | Commercial Plumbing Fixtures

1. FLUSH VALVE GENERAL REQUIREMENTS

- A. In general, provide sensed flush valves on urinals and manual flush valves on water closets.
 - B. Sensed flush valves are to be hardwired.
 - C. Power transformer to be provided by flush valve manufacturer.
 - D. Transformer to be located above accessible ceiling.
 - E. Power wiring to transformers and low voltage wiring to flush valves to be shown on electrical plans. Coordinate number of transformers required and allowed wire lengths with basis of design manufacturer.
 - F. At minimum, provide one transformer per restroom; do not share one transformer between two adjacent single-user restrooms.
 - G. Provide line-voltage switch upstream of each transformer.
 - H. Flush valve and water closet are to be sized to accept a 1.6 GPF diaphragm.
 - I. Angle stops at flush valves are to be ball valves.
 - J. Automatic and manual flush valve manufacturers:
 - 1. Sloan Valve Company
 - 2. Zurn Industries
 - 3. Delany (Medical Campus only)
 - 4. Approved Equal (Approval required prior to bid via substitution request)
2. CARRIERS
- A. Generally, fixtures should be wall-hung and not floor-mounted.
 - B. Carriers should be extra-heavy duty rated with a static rating of 750 lbs.

Section 22 4500 | Emergency Plumbing Fixtures

1. EMERGENCY SHOWER GENERAL INFORMATION

- A. OSHA requires all facilities to install emergency eyewash and shower stations “where the eyes or body of any person may be exposed to injurious corrosive materials.” The Kentucky Occupational Safety and Health Program (KYOSH) in 803KAR2:310 modified the Federal Standard by adopting the American National Standards Institute's Standard (ANSI Z358.1-1990) for emergency eyewash and safety shower equipment
- B. NIH and CDC in the Biosafety in Microbiological and Biomedical Laboratories (BMBL) requires emergency eyewash and shower equipment be accessible for BSL-2 and greater labs and all animal (ABLS) facilities.

2. GENERAL EMERGENCY SHOWER SPECIFICATIONS

- A. The following outline the University's technical standards and preferences to provide safety equipment to meet this mandate:
- B. Plans and drawings must show location of safety shower and eyewash units; specifications must be provided for review & approval by UK EHS.

3. PHYSICAL REQUIREMENTS FOR EMERGENCY SAFETY SHOWER

- A. For potential corrosive chemical exposures, emergency safety showers shall be located in an immediately accessible area within the laboratory unit or other work areas where the user shall not have to pass through a corridor door to reach the unit.
 - B. Emergency safety showers shall be identified with a highly visible sign and a green cross located as an integral part of the floor directly under the shower.
 - C. Safety showers installed in remote locations must be provided with an audible warning buzzer and visual alarm the audible and visual alarms shall be different than those used for fire, but the devices need not be larger or louder than those for fire alarms. The buzzer and visual alarm will be located above the door of the room with the shower. If feasible, an alternative alarm method connecting flow valves electronically to a twenty-four hour per day, seven days per week monitoring facility is preferred.
4. PHYSICAL REQUIREMENTS FOR EMERGENCY EYEWASH EQUIPMENT
- A. Emergency eyewash equipment shall ensure that a controlled flow of potable water is provided to both eyes simultaneously at a velocity low enough not to be injurious to the user following, as a minimum, the guidelines of ANSI Z358.1-1990.
 - B. Emergency eyewash units shall be located in an immediately accessible area within the laboratory unit or other work area where the user shall not have to pass through a door to reach the unit.
 - C. Emergency eyewash shall be identified with a highly visible sign and if floor or wall mounted, provided with a green cross located as an integral part of the floor directly under the eyewash or on the wall directly behind the eyewash unit.
 - D. There shall be no sharp projections anywhere in the operating area of the unit.
 - E. The unit shall be located to provide enough room to allow the eyelids to be held open with the hands while the eyes are in the water stream.
 - F. The control valve shall be designed so that the water flow remains in the on position without the use of the operator's hands and must remain open until manually shut off. The valve shall be large enough to be easily located and operated by the user. The valve shall require only one motion to activate the water flow.
 - G. Emergency safety showers are to have blending valve to deliver "Tepid" water at a temperature of 60° F - 95°F
 - H. The unit shall be installed with drainage in new construction and whenever possible during renovations. Drains are to have trap primers.
 - I. Emergency eyewash and shower equipment must be installed in every lab that is provided with a fume hood. Laboratories sharing a common suite or area not separated by closed doors may find one emergency shower is sufficient, but each lab unit must be equipped with an approved eyewash.
 - J. Eyewashes shall also be installed in any health care location where required by applicable regulations.

Section 22 6600 | Chemical-Waste Systems for Laboratory and Healthcare Facilities

- 1. PIPING MATERIAL: Any new or replacement waste line piping from labs and areas with acid waste shall be provided as described below:
 - A. POLYPROPYLENE acid-waste piping: flame-retardant Schedule 40 polypropylene per ASTM D4101 and ASTM F1412, manufactured and provided by one manufacturer.

Below-grade acid waste and vent piping shall be flame-retardant Schedule 40 polypropylene with fusion joint fittings per ASTM D4101 and ASTM F1412.

Above-grade acid waste and vent piping in non-plenum areas shall be flame-retardant Schedule 40 polypropylene with mechanical joint fittings per ASTM D4101 and ASTM F1412. Fittings shall be fusion joint within walls and other inaccessible spaces. Mechanical joint fittings shall be utilized beneath sink cabinetry and within other accessible areas.

Acceptable manufacturers include: IPEX Enfield, Orion, and G F Sloane.

- B. CPVC acid waste piping: CPVC lab waste pipe, Schedule 40, manufactured to ASTM F441. Fittings manufactured to ASTM D4101 and D3311.

CPVC lab waste piping for use in plenum areas must have a flame spread rating of < 25 and a smoke-developed index of < 50 per IMC requirements. Joining method shall be solvent cement welding. Cement shall be a primer-less CPVC cement formulated for resistance to corrosive chemicals, manufactured in accordance with ASTM F2618 and F493.

Acceptable manufacturers include: Spears LabWaste, ChemDrain, and Xirtec.

- C. Above-grade acid waste piping in plenum: PVDF, Schedule 40, per ASTM F1673 with mechanical joint fittings meeting ASTM E84 for flame spread rating of < 25 and a smoke-developed index of < 50 per IMC requirements.

Acceptable manufacturers include: Enfield, Orion, and Watts.

2. GENERAL REQUIREMENTS:

- A. The Design Professional is responsible for assessing the compatibility of the proposed piping system with the lab chemicals planned for that application.
- B. All pipe, fittings, and joining material shall be supplied together as a complete system from one manufacturer.
- C. Acid waste pipe and fittings must be stored, installed, and tested according to manufacturer's current instructions and in full compliance with the Kentucky Plumbing Code.
- D. No acid waste piping shall be installed on any project until the installation crew has received on-site instruction by a qualified factory representative. Installation must be performed by trained individuals with current certification. Proof of training shall be included in project submittals.
- E. PVC plastic piping is unsuitable for use in acid waste drains.
- F. Installation shall be done in an orderly manner to facilitate future pipe replacement on an as-needed basis.

Section 22 6719 | Processed Water Equipment for Laboratory and Healthcare Facilities

1. REVERSE OSMOSIS EQUIPMENT

- A. All incoming water should be treated initially with a water softening/carbon system.
- B. The water from the softener system should be further treated using a RO water treatment system before going to the humidification or steam generation equipment.

- C. The incoming water to the RO system must be tempered using a mixing valve arrangement so that the water temperature is 77 F instead of using standard domestic cold water. This is required because lower water temperatures impact the ability of RO systems to maintain their product flow rate. Water production decreases approximately 3% for each degree below 77 F.
- D. The mixing valve arrangement should include check valves external to the mixing valve to prevent crossover.
- E. The system shall have a UV lamp for recirculation loops.
- F. There shall be no translucent piping or tanks.
- G. Test ports shall be provided at strategic points within the system. Coordinate specific points with FM and FMMC.
- H. The system shall restart automatically after a power outage.
- I. There shall be flow gauges – at the product, recirculation, and drain.
- J. The water systems should be connected to the campus Tridium Building Automation System using BACnet protocols. All points from the systems' controllers should be discoverable to Tridium with the following items being the minimum points that should be monitored on Tridium:
 - 1. RO System Status
 - 2. RO Output Water Resistivity
 - 3. RO System Loop Pressure
 - 4. RO Total Dissolved Solids
 - 5. RO Product Flow Rate
 - 6. RO Loop Pumps (if applicable) Command and Status
 - 7. RO System Alarms from the system control panel
 - 8. RO Tank Level Alarm (if system has tank)
 - 9. RO Inlet Water Pressure (trend and provide low pressure alarm)
 - 10. Softener System Status
 - 11. Softener Salt Level Alarm
 - 12. Softener System Alarms from the system control panel
 - 13. Softener Flow Rate

REVISION DATE	PAGES	REMARKS
August 5, 2024	4, 6	Added non-potable water to identification list. Added option for copper sanitary waste and vent.
August 7, 2024	5	Updated PIPE AND FITTING SCHEDULE – EDUCATION CAMPUS. No longer allows press fittings above 2"
December 20, 2024	4 10	Separated label for sanitary and vent systems Reformatted and added RO Systems
March 26, 2025	8	Added Delany as an acceptable flush valve manufacturer for the medical campus. Added requirement for flush valve angle stops to be ball valves.
May 20, 2025	6	Prohibited strapless branch outlets