

DIVISION 22 - PLUMBING

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22 00 01. General:

1. Plumbing specifications shall be properly coordinated with Division 01 00 00- General Requirements, Division 33 30 00- Sanitary Sewerage Utility standards, and Division 33 40 00- Stormwater Utility standards Plumbing Specifications shall conform to the format and organizational requirements stated in the introduction of these standards.
2. All value engineering (VE) items, materials and methods shall be identified during the conceptual design phase. These shall be reviewed by the EM and shall be incorporated in the design by the engineer of record.

22 00 02. Scope:

1. This division covers all plumbing systems within the building and up to 5' from the building foundation for potable water, sanitary sewer, and storm sewer. All water, sewer and storm sewer utilities in the street are part of division 3300. Hydronic piping is part of division 2300. These are referenced in this section for coordination only. This division covers the following plumbing systems:
 - 1.1. Potable cold and hot water distributions.
 - 1.2. High Purity Water Systems.
 - 1.3. Drain waste and vent system.
 - 1.4. Laboratory drain waste and vent system.
 - 1.5. Storm water system.
 - 1.6. Pressure booster system.
 - 1.7. Insulation for potable water, pumps, plumbing fixture connections and any other items requiring potable water connections.
 - 1.8. All Plumbing fixtures and their hangers.
 - 1.9. Potable Hot water heaters.
 - 1.10. Natural gas piping.
 - 1.11. Compressed air.
 - 1.12. Medical gases, compressed air, and vacuum.
 - 1.13. Food service plumbing.
 - 1.14. Fuel oil line systems.

22 00 03. Prohibited and not allowed materials and practices:

1. **PROHIBITED:** Victaulic fittings for potable cold & hot water piping. See Table A & B.
2. **PROHIBITED:** PEX piping for potable cold and hot water piping. See Table A & B.

3. **PROHIBITED:** PVC and other plastics for sanitary & storm sewer piping underground.
4. **PROHIBITED:** Staples and other forms of mechanical fasteners in all insulation vapor barrier jackets.
5. **PROHIBITED:** Compression fittings for the water risers to the plumbing fixtures.
6. **PROHIBITED:** Single pass non-contact cooling water to sanitary sewer, per MCES section 406.00.
7. **PROHIBITED:** Easily removable fixtures with integral traps shall not be used for cleanouts.
8. **PROHIBITED:** 1-1/4" traps.
9. **PROHIBITED:** 1/8 gallon per flush urinals.
10. **PROHIBITED:** Type M copper.

22 00 04. Design Intent Report:

1. The Architect/Engineer (A/E) shall provide a design intent report at the preliminary design phase that documents the following:
 - 1.1. Water conservation measures and total water requirements for the proposed building
 - 1.2. Noise criteria arising from the sanitary and storm piping in occupied areas.
 - 1.3. Choice of piping materials and plumbing fixtures
 - 1.4. Proposed variances to the codes and standards and their justifications.
 - 1.5. B-3, SB-2030 and any other applicable standards compliance measures when required.
 - 1.6. Sustainability methods and measures
 - 1.7. Pipe sizing methodology and diversity assumptions
 - 1.8. 50-year design considerations and its impact on plumbing fixtures, and plumbing materials selection.
 - 1.9. Alternates and proposed value engineered construction materials and construction methods.

22 00 05. Coordination with University of Minnesota departments:

1. The architectural and engineering consulting firm (A/E) shall coordinate with the following departments to ensure that the user needs are satisfied, including but not limited to:

- 1.1. Facilities Management (FM)
 - 1.2. U of M Building Code Department
 - 1.3. Capital Project Management (CPM)
 - 1.4. Office of Classroom Management (OCM)
 - 1.5. Health and Safety & Risk Management (HSRM)
 - 1.6. Disability Resource Center
 - 1.7. Food Service
 - 1.8. Parking and Transportation Services (PTS)
 - 1.9. Central Security
 - 1.10. Office of Information Technology (OIT)
 - 1.11. University of Minnesota Policy Department (UMPD)
 - 1.12. Energy Management
 - 1.13. University Planning
 - 1.14. Operations and Maintenance
2. The A/E shall coordinate with the proper utilities for potable water, irrigation water, and sanitary & storm sewer, and natural gas connections.
 - 2.1. The architect shall work with the mechanical/plumbing engineers to ensure that the equipment installation meets the architectural requirements of the building. All mechanical/plumbing equipment shall be located inside the building. All exceptions shall be presented during the conceptual design phase.
 - 2.2. The minimum size of all sanitary vent through roof (VTR) shall be 4” and shall extend at least 18” above the finished roof level.

22 00 06. Access for maintenance:

1. The location of equipment shall be determined by its service need, so it can be easily maintained. In mechanical spaces, when the equipment is located 6 feet or higher above the ground, a service platform with proper fall protection shall be provided that complies with OSHA requirements for service and maintainability.
2. The A/E shall coordinate the plumbing design with other disciplines to provide adequately sized and properly located access panels.
3. Access to all roof top equipment shall be provided by a permanent ladder. All equipment within 10 feet of the roof edge shall have OSHA approved Railings.

22 00 07. Plumbing Drawings:

1. Plumbing drawings shall be clearly delineated at an appropriate scale to accurately define piping, roof penetrations, plumbing fixtures, and equipment.

22 00 08. Coordination with other trades:

1. Plumbing systems shall be coordinated with the building design and construction, as well as with electrical, heating ventilation and air conditioning (HVAC), fire protection, temperature controls, network controls, and other systems to eliminate construction conflicts. All sanitary and storm sewer outside the building shall be coordinated with Division 3300

22 00 09. Materials, Manufacturers and Suppliers:

1. Whenever possible, equipment specified and provided shall be of a type and manufacturer that has a local representative and a local replacement and service outlet to give complete coverage on parts and service at all times. All equipment and materials manufactured by OUS shall be identified during conceptual design and approved by the U of M.
2. All factory-assembled equipment shall incorporate materials and fabrication methods consistent with these standards. All factory-assembled equipment shall meet all MN codes, U of M Standards. Any electrical equipment shall have UL.

22 00 010. Equipment Bases:

1. Basement Floors: Concrete bases with a 3-1/2-inch minimum height shall be provided under all floor-mounted mechanical/plumbing equipment, such as booster pumps, hot water heaters, water tanks etc.
2. Base size and location shall be coordinated with the equipment specified and shall be shown on the architectural and structural drawings. Mechanical equipment (pumps) shall be installed using vibration isolators. The vibration isolators shall be per equipment manufacturer's recommendations.
3. Concrete Floor above the Basement: Inertia bases shall be provided for all moving machinery such as recirculating pumps and booster pumps. Base size and location shall be coordinated with the equipment specified and shall be shown on the architectural and structural drawings. Mechanical equipment (pumps) shall be installed using vibration isolators. The vibration isolators shall be per equipment manufacturer's recommendations.

22 00 011. Painting:

1. All piping, insulation, and other equipment that is exposed in finished and unfinished spaces shall be painted in accordance with Division 09 91 00 or as directed by the A/E firm.

22 00 012. Existing Facilities:

1. For remodeling projects, the University of Minnesota shall provide openings in walls and ceilings as required and where the A/E requests to permit verification of existing piping, and equipment. Any penetrations requiring x-rays shall be reviewed and approved by the structural engineer prior to any work.

22 00 013. Building Service Outages:

1. The A/E shall coordinate the service outages requirement with the Preconstruction Meeting Agenda form located in the Forms Section.
2. Service Outage Request: The contractor shall request all building service outages through the owner's representative. See Appendix KK for outage request.
3. Impairment Procedures: Request for impairments of fire protection system or fire alarm system requires a 24-hour notice. Refer to Division 21 00 00 - Fire Protection Systems and Division 21 30 00 - Fire Pumps for specific impairment procedures.
4. Fire Safety Precautions: The A/E shall include the following or similar statement in the specifications regarding protective measures for the contractor during grinding, cutting, brazing, sweating or welding operations.
 - 4.1. All grinding, cutting, brazing, sweating, or welding operations carried on in the vicinity of, or accessible to combustible material, shall be adequately protected to make certain that a spark or hot slag does not reach the combustible material and start a fire.
 - 4.2. When it is necessary to do grinding, cutting, brazing, sweating, or welding close to wood construction in pipe shafts or other locations where combustible materials cannot be removed or adequately protected, employ fireproof blankets and proper fire extinguishers. A helper shall be stationed nearby to guard against sparks and fire.
 - 4.3. Whenever combustible material has been exposed to molten metal or hot slag from welding or cutting operations or spatter from electric arc, a fireguard shall be kept at the place of the work for at least one hour after completion to make sure that smoldering fires do not start.
 - 4.4. When welding or cutting in a vertical pipe shaft or floor opening, a fireguard shall examine all floors below the welding or cutting operation. The fireguard

shall be kept on duty for at least one hour after completion of work to guard against fires.

- 4.5. Before grinding, cutting, brazing, sweating, or welding, consult with the A/E as to safety precautions.
- 4.6. In the case of a remodeling project in an existing building or connection of a new building to an existing building, the A/E also shall include in the specifications all the mandatory requirements described in Standard Operating Procedures for Hot Works form located in the Forms Section.

22 00 014. Mechanical Equipment Rooms, Penthouse Access:

1. All plumbing equipment requiring ventilation for proper operation shall be coordinated with the HVAC contractor.
2. Plumbing equipment shall be located, sized, and arranged in a space that provides easy access for maintenance, repair and future replacement. The equipment also shall be enclosed to separate it from other building functions.
3. Where heat-generating equipment is situated adjacent to or above occupied spaces, the equipment shall be ventilated. In addition, the floors, walls, and ceilings shall be insulated with permanently attached, durable, and fire-resistant insulation to provide a “U” (overall heat transfer coefficient) value through the wall or ceiling not to exceed 0.15 BTU/hr. sq. ft. °F. No exposed fiberglass insulation shall be utilized.
4. Adequate provisions shall be made in mechanical space to support equipment, piping and piping-related work.
5. Equipment, and piping and in such rooms shall be mounted or suspended in a manner that will isolate it from the system and from the structure to prevent noise and vibrations in adjacent spaces and provide provisions for thermal expansion and contraction.
6. No plumbing equipment of any type shall be placed in building areaways or tunnels. No piping shall run into or through fresh air plenums and/or air ducts.

22 00 015. Operating Instructions:

1. Refer to Division 01 78 23 - General Requirements. Contract Closeout Submittals for additional information on equipment maintenance and operations manuals.
2. Specifications shall clearly define the responsibilities of the contractor and the manufacturers to provide instructions to the designated university personnel in the proper operation and maintenance of all plumbing equipment provided. The schedule for the training shall be coordinated with the owner’s representative and the commissioning agent as appropriate.

22 00 016. Energy Information:

1. The U of M operates its own central steam, chilled water, central compressed air, and primary electric distribution systems. For utility service to new buildings or existing buildings being remodeled, contact the University Energy Management Utility section for information on utility services availability and installation requirements to connect to the central systems.
2. Specification for new university buildings shall include a section that identifies the peak and monthly water and utility requirements of the buildings. The requirements shall include potable water, compressed air, and gas services. Provide both design load and estimated load.
 - 2.1. Potable Water
 - 1A.Design Load: GPM and gallons per month
 - 1B.Installed Capacity: GPM and gallons per month.
 - 1C.Design potable water use on a design day
 - 1D.Estimated Load Profile: Gallons/month for a 12-month period
 - 2.2. Gas
 - 2A.Estimated Load Profile: Therms/month for a 12-month period
 - 2B.Design Demand: Peak usage, cubic ft/hr. on a design day
 - 2.3. Compressed Air
 - 3A.Estimated peak load and operating pressure during occupied and unoccupied building.

22 00 017. Energy Conservation:

1. Refer to the section on Energy Efficient Design in Program Information/Requirements for energy conservation design requirements. Compliance with state and other applicable mandate is required.
 - 1.1. State of MN Buildings Benchmark & Beyond (B3)
 - 1.2. Sustainable Buildings (SB) 2030
 - 1.3. University of Minnesota Climate Action Plan

22 00 018. Industry Standards:

1. In addition to the requirements of the regulatory agencies listed in Division 01 00 00 - General Requirements, Division 01 41 13 - Building Code Regulatory Requirements, the design and construction shall conform to the latest edition of the following standards where applicable:

- 1.1. American Concrete Institute
- 1.2. American Conference of Governmental Industrial Hygienists c. American Institute of Steel Construction
- 1.3. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineering
- 1.4. ASME: American Society of Mechanical Engineers
- 1.5. ASTM: American Society for Testing Materials
- 1.6. AWWA: American Water Works Association
- 1.7. American Welding Society
- 1.8. National Bureau of Standards
- 1.9. National Commercial and Industrial Insulation standards
- 1.10. NFPA: National Fire Protection Association
- 1.11. AGA: American Gas Association
- 1.12. ASPE: American Society of Plumbing engineers
- 1.13. American society of sanitation engineers
- 1.14. NSF: National sanitation foundation
- 1.15. ANSI: American National Standards Institute
- 1.16. CISPI: Cast Iron Soil Pipe Institute

22 00 019. Welding and Brazing:

1. Certified and licensed trades persons shall perform all piping welding and brazing. Certification shall be for the type of work being performed and shall be accomplished in accordance with the "Qualification Standard for Welding Procedure, Welders and Welding Operators" as specified by ASME or appropriate governing agency for brazing.
2. An independent testing laboratory shall radiograph selected joints, which shall be evaluated on the basis of API and ANSI construction standards appropriate for the service. The A/E shall identify the standard applicable for each welded system.

22 00 020. Electrical Requirements:

1. The A/E shall supplement specifications with the necessary control diagrams for any plumbing equipment requiring electrical connections. The diagrams shall clearly define the sequence of operation, as well as the responsibilities of plumbing and electrical subcontractors.

22 00 021. Excavation and Backfill for Underground Plumbing Work:

1. Scope is limited to within the building and extending up to 5' from the perimeter walls.

2. The requirements specified in Division 31 – Earth Work shall be applicable to this work, including protecting, sheathing and shoring, blasting, compaction filling, compaction testing and grading.

22 00 022. Equipment Isolation:

1. The specifications shall include isolation valves. All equipment must be installed with isolation valves for shutoff service. The valves must have flanged or screwed ends. If screwed, provide a union between equipment and valve. See table A and B for type of valves.
2. All piping systems including but not limited to the potable hot and cold-water systems must have a minimum of one isolation valve per building level, suite or room, or as directed by the U of M representative.

22 00 023. Equipment and System Cleaning:

1. The specifications shall include system-cleaning requirements. After hydrostatic tests and prior to operating tests, equipment, including all potable cold and hot water piping and equipment shall be thoroughly flushed and cleaned. The cleaning procedures and all chemicals used shall be reviewed with the HSRM and the U of M designated person.
2. All piping systems shall be cleaned and disinfected before they become operational. Exception: Sanitary and storm sewers are not required to be disinfected. Coordination of the activity with the U of M District is required. Disinfecting shall be done to meet the minimum requirements as required by HSRM.
3. After the solution has cleaned the system, the solution shall be drained and thoroughly flushed with fresh water from the system. After initial cleaning, the owner's representative or designer shall sign and certify that the system has been thoroughly cleaned. Any cleaning water that cannot be drained to the city sewer system shall be removed from the site by the contractor and disposed of per local and State requirements.

22 00 024. Soil Pipe Protection:

1. The A/E shall analyze a soil conditions report that an independent testing agency prepares to determine the cause for accelerated deterioration of pipes. Where such conditions occur, suitable materials and construction techniques shall be specified.
2. Attempt to avoid installing pipes in cold spaces. All plumbing installed in cold spaces shall be protected from freezing. Review protection with U of M district's trades persons.
3. Pipe hangers and spacing shall be in accordance with MN plumbing code. Each pipe section of horizontal runs of cast iron, acid resisting piping and glass pipe hanger spacing shall be in accordance with the pipe manufacturer's recommendations. Plastic piping shall be supported at 4-6 feet based on the pipe size and in accordance with the

manufacturers' recommendations. Plastic piping under pressure shall be continuously supported in angle iron or metal channel. Pipe hanger spacing shall be reviewed with the U of M designated representative.

22 05 013. Common Motor Requirements for Plumbing Equipment:

1. All electrical motors up to and including 0.5 HP shall be 115-1-60. All motors above 0.5 HP shall be 460-3-60 or 208-3-60. All three phase motors shall be dual voltage: 208/230 and 460 volts. All motors shall be TEFC whenever possible.
2. All electrical motors shall be of high efficiency, 1.1 service factor and shall meet the latest applicable state energy codes.
3. All motors for the pressure booster equipment shall be TEFC. All motors located in the ambient shall be TEFC and protected from rain.
4. All motors utilizing a VFD shall have factory installed mating grounding rings.

22 05 019. Water Meters:

1. Coordinate all work with division 3300, and local water utility.
2. Incorporate water meters into the design of all new buildings.
3. The A/E shall determine if the water utility providing service shall furnish the building water meter and specify accordingly.
4. On the St. Paul campus, provide a three-valve by-pass on water meters. Install water meters and detector check valves inside the building wall immediately after the service pipe passes through the outside wall. The contractor shall furnish and install a water meter at every building. Water meters shall have a valve before and after the meter. The meter shall be identical to typical meters that the Saint Paul Board of Water Commissioners uses. The responsible professional designer shall size a separate fire service if the building has a sprinkler system. The contractor shall furnish and install the detector check valve. No bypass meter on the detector check valve is required. The fire service pipe and domestic service pipe shall be separate with individual taps and valves at the main.
5. Install water meters and detector check valves inside the building wall immediately after the service pipe passes through the outside wall. The Minneapolis Water Department shall furnish the main domestic water meter, fire protection bypass meter for the contractor to install. The contractor shall coordinate and provide whatever labor and materials are required to accommodate the type of meter provided by the city. The responsible professional designer shall size the fire service pipe. The contractor shall furnish and install the detector check valve with a bypass meter. The fire service pipe and

domestic service pipe shall be two pipes with separate manholes, taps and valves at the main as required by the City of Minneapolis.

6. Provide deduct water meters of a type approved by the water utility to meter cooling tower make up and blow down, and irrigation systems.
7. The city providing the water service shall approve the water meters and register consumption in cubic feet.

22 05 023. General-Duty Valves for Plumbing:

1. Only ball valves butterfly valves are allowed. See table A and B for details.
 - 1.1. Valves shall use chain operators when necessary.
 - 1.2. Valves shall be suitable for the fluid service.
 - 1.3. Valves in accessible areas shall be secured.
 - 1.4. Valves for all major piping systems shall be ball valves unless noted otherwise on the drawings. 3-piece ball valves are not allowed.
 - 1.5. Provide a bypass on all actuated valves unless noted otherwise.
 - 1.6. PVC valves shall be true union type.
 - 1.7. Use threaded connections for pipes that are 3 inches and smaller, except for concealed gas piping, which is to be welded. Use flanged connections for pipes 4 inches and larger unless noted otherwise. PVC/thermoplastic valves that are 3 inches and smaller shall have sockets. PVC/thermoplastic valves that are 4 inches and larger shall be flanged.
 - 1.8. The minimum rating for valves shall be one and a half times the maximum system pressure.
2. Balancing Valves: Ball valves with memory stops shall be specified for balancing systems.
3. Gate Valves: Gate valves are not allowed.
4. Butterfly Valves
 - 4.1. Valves used for compressed air, potable water service up to 150 degrees F shall be lug type. They also shall be of a threaded lug style or a flanged style with extended necks, cast iron body, ANSI Class 125 or ANSI Class 150 compatible flanges, 316 stainless steel shaft and disc, hand lever with 10 position notch plate, EPDM seat. Valves must be rated for a minimum of one and half times the design pressure or they shall not be permitted.
 - 4.2. Butterfly valves are allowed for 4" and larger pipes.

- 4.3. Butterfly valves used for isolation shall be bubble tight.
5. Ball Valves
 - 5.1. Ball valves shall be specified full port NPT.
 - 5.2. All ball valves shall be supplied with stainless steel trim unless material is not compatible with the fluid.
 - 5.3. Ball valves specified for insulated piping systems shall have extended stems. Stems shall be of sufficient length to allow free operation of the handle.
 - 5.4. Ball valves that are 2 inches and smaller shall be screwed valve, bronze body, stainless steel stem and ball, with Teflon seat or university-approved equal. All ball valves 2-1/2" to 3" can be NPT or flanged.
 - 5.5. PVC ball valves shall be rated at a minimum of 150 psig and shall be true union.
6. Globe Valves: Only allowed for modulating controls.
 - 6.1. Valves for water service shall be ANSI Class 150 minimum, made of brass body with stainless steel trim and have a rising stem.
7. Hydrants: Provide frost-proof sill cocks on all sides of new buildings. Each sill cock shall be equipped with a non-pressure type vacuum breaker and interior shut-off valve.
 - 7.1. Hydrants may be provided with integral vacuum breakers. Hydrants without integral vacuum breakers shall be provided with a field-testable dual check valve backflow preventor, ASSE 1052-approved and as approved by the State of Minnesota, similar to Woodford Model 67. Indicate all exterior hydrants to have loose key operating handle.
8. Check Valves
 - 8.1. Check valves for compressed air system, and potable water and service shall be as follows:
 - A. Valves 2 inches and smaller shall be screwed end, bronze body, 150-pound, WOG, with replaceable disc. Swing checks shall be Milwaukee 510 or university-approved equal. Spring checks shall be Symmons model 506 SB or university-approved equal.
 - B. Valves 2-1/2 inches and larger shall be NPT or flanged ANSI Class 150, with replaceable disc: Milwaukee No. 1570 or university-approved equal.
9. Gas Valves

- 9.1. Valves on gas systems 2 inches and smaller shall be bronze body UL listed for the gas service, rated at 200 pounds, WOG, with screwed ends. Ball valves meeting these requirements are acceptable.
- 9.2. Valves on gas systems 2-1/2 inches and larger shall be iron body, rated at 200 pounds, WOG, with flanged ends. These shall be UL listed for the gas service.
- 9.3. Medical gas and medical vacuum valves shall comply with the current edition of NFPA 99, Standard for Health Care Facilities.
10. Oxygen Valves: Valves on oxygen main piping shall be National Cylinder Gas 2500 Series valves or university-approved equal. Valves shall be brass, or bronze diaphragm type globe valves of leak-proof construction. Valves shall be UL listed for this service.
11. Faucets. See plumbing fixtures, and special fixtures for fixture trim and valves.
12. Mixing Valves: All mixing valves for photo processing, emergency showers and personal use shall be Bradley, Symmons or university-approved equal and contain integral check stops. Isolation valves with check valves are required on all mixing valve applications. These shall comply with the latest MN OSHA requirements.

22 05 029. Hangers and Supports for Plumbing Piping:

1. **PROHIBITED:** Torch cut hanger rods and support members in trapeze hangers.
2. **PROHIBITED:** Clevis hangers for hanging pipes with longitudinal expansion and contraction.
3. Suitable trapeze hangers, Clevis hangers, approved Phillips shields or heavy line hangers shall support piping. Piping also shall be supported from concrete inserts or university-approved concrete anchors.
4. Hanger rods for piping supports shall comply with the following chart:

Pipe Size	Hanger Rod Diameter
Up to 2 inches	3/8 inch
2 ½ to 3 ½ inches	½ inch
4 to 5 inches	5/8 inch
6 inches	¾ inch
8 to 12 inches	7/8 inch

5. Hangers for insulated piping shall be large enough to encompass the insulation and the metal saddle.
6. Specify riser clamps to support vertical risers on every floor.

7. Sleeves: All sleeves shall incorporate matching and close-fitting escutcheon plates.
 - 7.1. All pipe sleeves through slabs, walls and partitions shall be fabricated from new material, cut square and reamed. Sleeves shall be large enough to allow full thickness of pipe insulation.
 - 7.2. Space between the piping/insulation and sleeve shall be sealed with an approved fire-rated caulking material on all fire-rated walls. Space between the piping/insulation and sleeve shall be sealed with an approved waterproof caulking at wet walls and through floor slabs. Sleeves through exterior walls shall be provided with link-seal or university-approved equal mechanical sealing system between sleeve and pipe. Where necessary, provide fire-rated caulking and waterproof caulking material. On vertical sleeves, the sealant shall be applied flush with the top of the sleeve to make a watertight joint. Refer to Division 7, Section 07 27 00 – Fire-stopping.
 - 7.3. Sleeves through Walls
 - 3A. Sleeves through interior masonry partitions and exterior building walls shall be made of Schedule #40 steel pipe that extends through the wall. The sleeves also shall be flush with the finished surface.
 - 3B. Sleeves through gypsum wallboard partitions shall be made of 22-gauge galvanized steel up to 3 inches in diameter, and minimum 16-gauge for anything larger. The sleeves also shall be flush with the finished surface.
 - 7.4. Sleeves through Slabs
 - 4A. Generally, no sleeves are required through slabs on grade.
 - 4B. Sleeves through roof slabs shall be made of minimum 16-gauge galvanized steel.
 - 4C. Sleeves through floor slabs in exposed areas such as classrooms, offices, and corridors, shall be made of Schedule #40 steel pipe that extends 2” inch above the finished floor. Core drilling in lieu of coordinate sleeve locations prior to the concrete pour is acceptable if proper radiographic methods are used for all core drillings. Same radiographic methods are used for the remodeling projects.
 - 4D. Sleeves through floor slabs for piping in chases, and within walls and partitions shall be made of minimum 16-gauge galvanized steel. Sleeves shall extend 1/2 inch above the floor surface. Sleeves for water closets shall be of 16-gauge galvanized steel.
 - 4E. Where exposed covered piping passes through floor slabs in kitchen areas and hospital areas, the covering at floor shall be encased with an 18-gauge, stainless steel, cylindrical sleeve that is 6 inches high with lap joints fastened by two stainless steel metal screws. In other exposed areas, an 18-gauge galvanized steel sleeve may be used.

- 7.5. Fire-stopping and waterproofing design for materials between the pipe and the sleeve must be detailed on the plans.
8. Support for Exterior Piping. Scope of work limited to 5' from the building exterior.
 - 8.1. All sanitary and storm sewers that extend from a building shall be cast iron for 5 feet from the building. Where cast iron pipe enters or leaves the building, a sleeve shall be provided in the wall with 'Link-Seal', or a university-approved equal mechanical sealing system shall be provided between the sleeve and pipe.
 - 8.2. All services leaving the building that are laid on filled earth, including sanitary sewer, storm sewer and water main, shall be supported at each joint and elbow on reinforced concrete beams until the pipe rests on solid undisturbed soil.
 - 8.3. Concrete beams shall bear on a ledge or pocket in the foundation wall, and on at least 5 feet of solid undisturbed ground beyond the excavation. The mechanical subcontractor is responsible for the construction of the beams. The contractor or subcontractor responsible for constructing the foundation wall also shall provide the ledges or pockets for the walls.
 - 8.4. The mechanical subcontractor shall have complete responsibility for the proper installation of all exterior underground piping up to 5 feet from the building perimeter. The mechanical subcontractor also shall guarantee these lines against breakage and be liable for all damage, repairs and replacement caused by settling of pipe or back-fill for the corrections period specified in the General Conditions.
9. Mechanical Systems Identification:
 - 9.1. All piping labels shall conform to Pipe Marking Guide, ANSI/ASME A13.1 - 2020.
 - 9.2. All piping shall be labeled every 20 feet and at every change of direction as to type of service and direction of flow. Markers shall be Seton or of equal plastic kind, secured by approved plastic banding. A black arrow on the markers shall indicate the direction of flow. Letters shall have a minimum height of 1 inch.
 - 9.3. All manually operated service valves and automatic control valves not immediately in sight of the fixture or equipment it serves shall include approved 19-gauge brass or 0.032-inch aluminum tags secured with brass "S" hooks or chain. Tags shall be stamped with an identifying number. The contractor shall provide a tabulation that cross-references the valve numbers to a description of the valves and equipment, or piping controlled in terms of A/E room numbers.

- 9.4. Valve tag numbers shall correspond to valve numbers on drawings and control diagrams and sequence of operation.
- 9.5. The A/E shall specify the necessary clearance for the maintenance, repair and replacement of valves, and other fittings.

22 06 00. Plumbing Schedules:

1. All schedules shall be shown on drawings. Schedules shall contain all pertinent information such as performance characteristics, make and model numbers, power requirements, voltage, phase, and horsepower.

22 07 00. Plumbing Insulation:

1. The installation of the pipe insulation system shall be specified to require a continuous vapor barrier. In addition, the insulation contractor shall prepare a mock-up showing how they will deal with the insulation of all fittings, i.e. couplings tees, valves, etc. Field applied fittings insulation is not allowed, only factory-made insulation fittings are allowed. This shall be inspected and approved by the Engineer of record, and representatives of both the FM District and FM Energy Management.
2. **PROHIBITED:** Insulation containing asbestos, staples, and screws.
3. General Provisions for Fire and Smoke Hazard Rating: All insulation shall have a system fire and smoke hazard rating as tested by procedure ASTM-E84, NFPA 255 and UL 723, not exceeding Flame Spread 25 and Smoke Developed
4. The system rating shall be based on insulation, jacket, adhesives, coatings, fittings, and cements. Any treatment of jackets or facings to impede flame and/or smoke shall last the life span of the jacket.
 - 4.1. Minimum insulation thickness shall comply with the Minnesota Mechanical Code
5. Jacket
 - 5.1. **PROHIBITED:** Stapling pipe covering.
 - 5.2. PVC jacket: On piping 3 inches and larger, install 30-mil thick PVC covering over insulation of all piping located in shafts, manholes and tunnels. In addition, install PVC covering for outside applications that are subject to exposure to water. On piping smaller than 3 inches, install 20-mil thick PVC covering. Stop PVC jacket 2 inches from exposed metal on valves, traps and unions, and finish with CP-11.
 - 5.3. Canvas jacket: Canvas jackets are not allowed unless required for special applications.

- 5.4. Insulated piping lines running outdoors shall have a 30-mil ultraviolet-rated PVC jacket installed over the insulation and vapor barrier.
 - 5.5. All jacketing shall be continuous with vapor seal throughout system.
 - 5.6. All fiberglass pipe covering shall have a factory-applied, all-service jacket.
6. Protection at Hangers
- 6.1. **PROHIBITED:** Wood block inserts.
 - 6.2. Pipe insulation shall be continuous and protected at hangers and support points. Specify Buckaroo or equal shields with flared ends or university-approved equal for installation at each hanger or support point. Shields on pipe/insulation that are 2-1/2 inches to 5 inches in diameter shall be 22 gauge. Shields on pipe/insulation that are 6 inches to 12 inches in diameter shall be 20 gauge.
7. Pipe and Fittings Insulation
- 7.1. General Requirements
 - 1A. Insulate the following piping:
 - 1B. Roof drain bodies and horizontal rain leaders, primary and overflow piping.
 - 1C. Domestic hot and recirculating water lines
 - 1D. Cold water lines
 - 1E. Horizontal air conditioning condensate drain lines.
 - 1F. Fuel oil lines, where necessary or exposed to low temperatures.
8. Other piping systems above and below ambient temperature
- 8.1. The maximum temperature limit of the insulation must be above the maximum operating temperature of the piping. The minimum temperature limit of the insulation must be below the minimum operating temperature of the piping.
 - 8.2. New insulation covering shall be white or as directed by the U of M representative. If this conflicts with existing color-coding of pipes, stencil new insulation per OSHA 29 CFR 1926.1101 to identify it as non-asbestos covering.
 - 8.3. Insulate fittings, flanges, unions, and valves. Insulation covers shall be either prefabricated or fabricated of pipe insulation. Insulation efficiency shall not be less than that of the adjoining piping. Specify that insulation vapor barrier be installed continuous and unbroken.

- 8.4. The A/E shall specify the type and thickness of the insulation based on the pipe size and the exposure. Minimum insulation thickness shall comply with the Minnesota Mechanical Code. Select a thickness of insulation for cold piping that prevents condensation on the surface of the insulation, as well as has an ambient temperature 50 degrees F warmer than the pipe temperature. Specify that the insulation be installed with a continuous unbroken and non-punctured factory-applied vapor barrier. Insulation shall meet or exceed the latest ASHRAE Standard 90A for energy conservation.
9. Piping and Fitting Insulation for Domestic Water Systems, Rain Leaders and Roof Drains, overflow piping, condensate drain.
 - 9.1. **PROHIBITED:** Foamed plastic or flexible elastomeric insulation on domestic hot water pipes
 - 9.2. Domestic water systems, rain leaders and roof drains shall be insulated with fiberglass.
 - 9.3. Horizontal rain leaders, horizontal overflow and bodies, and roof drain bodies shall be insulated with 1-inch fiberglass with continuous vapor barrier.

10. Drainage Pipe Insulation

- 10.1. All horizontal rain leaders and horizontal overflow piping below roofs shall have a 1-inch-thick fiberglass insulation with vapor barrier.
- 10.2. Horizontal air conditioning condensate drains shall be insulated the same as domestic cold water.

22 08 00. Commissioning of Plumbing:

1. Disinfecting Potable Water Systems

- 1.1. The contractor shall flush all new or extensively repaired water main systems until no dirty water appears at the point of water discharge. The new or repaired water main system shall then be disinfected. Disinfect with a water and chlorine solution of at least 50 parts per million (ppm) with contact to all parts of the system for at least 24 hours. The University HSRM Environmental Hygiene Officer shall approve any alternative disinfecting methods. An approved sampling line and/or tap shall be provided.
- 1.2. New or extensively repaired potable water building distribution systems shall be flushed until the water runs clear, and then disinfected. Disinfecting all parts of the potable water systems in the building shall be in accordance with procedures specified in the Department of Health, Minnesota Plumbing Code, Chapter 4715.
- 1.3. The HSRM Environmental Hygiene Officer shall be notified at least 48 hours prior to disinfecting any potable water system.

- 1.4. After disinfecting, the contractor shall flush the entire water system to reduce the chlorine concentration to 0.0 ppm or normal municipal levels.
- 1.5. Satisfactory bacteriological testing results of the water in accordance with the EPA Safe Drinking Water Act must be completed before placing the water service and/or system in service for consumption as potable water.

22 011 00. Building Water Distribution:

1. General Requirements: Ownership of the water distribution system is different on the Minneapolis campus and the St. Paul campus. The City of Minneapolis Water Department owns and installs water distribution mains, hydrants, and main domestic water meters in Minneapolis. The university owns water service taps and service pipe between the city main and the shutoff valve downstream of the main domestic meter. In St. Paul on the contiguous campus, the university owns all water works from the water main downstream from the two primary taps from the Cleveland Avenue water main.
2. Work with the University's Facilities Management, Twin Cities Water/Sewer Utility
3. Engineer to determine ownership for other St. Paul utilities. This document addresses the distribution mains, valves, hydrants, meters and service pipe before the shutoff valve downstream of the main domestic water meter or the detector check valve on the fire service.
4. Minneapolis Campus
 - 4.1. The City of Minneapolis Water Department shall furnish and install the new water distribution main or relocate the existing water distribution main. The university shall pay for main and service work, and it must be authorized through Facilities Management, Twin City Water/Sewer Utility Engineer. The cost for work required by a specific project shall be paid for by the project.
 - 4.2. Service taps shall be in manholes installed over the distribution water main. The contractor shall excavate, furnish, and install the manhole. The Minneapolis Water Department shall furnish and install the service tap and valve. The contractor shall schedule, coordinate, and pay for all work by the Minneapolis Water Department. The contractor shall hire a licensed plumber from the City of Minneapolis to be in charge of all water service work. If the water distribution main is under a public street, the City of Minneapolis shall restore the street pavement and curb. This work shall be paid for via a city street permit fee charged to the contractor. The contractor shall obtain the permit at City Hall.
 - 4.3. Water service pipe from the main to the building that is 3 inches in diameter and larger shall be ductile iron pipe, slip joint with rubber gaskets, AWWA Class 50 or thicker wall, and lined with concrete mortar. The pipe shall be laid perpendicular to the building wall and run in a straight line to the main. If a

bend is necessary, it shall be adequately braced with concrete against undisturbed soil. Water service installation plans shall be prepared and submitted to the Minneapolis Water Department for their approval a minimum of 30 days prior to actual service construction.

- 4.4. Water service pipe less than 3 inches in diameter shall be type K copper. Water service pipe less than 3 inches in diameter typically does not require a manhole at the main. The Minneapolis Water Department shall approve brass taps, corporation cocks and curb stops where appropriate.
- 4.5. All underground pipe shall be buried at least 5 feet underground. Trench excavation, pipe installation and backfill shall be in accordance with the pipe manufacturer's recommendation. Trench backfill shall be placed in maximum lifts of 12 inches and compacted to a minimum density of 92 percent in accordance with Modified Procter Density, ASTM D1557. No pipe joint shall be installed on disturbed soil in the backfill outside the building wall unless a structural beam anchored in the building wall is constructed under the water service pipe.
- 4.6. Occasionally, water distribution mains owned by the City of Minneapolis are not close enough to a new building to satisfy minimum fire protection codes for hydrants. It may be economically feasible to install water mains and hydrants outside the building that are supplied with water from within the building. In such an instance, the contractor shall perform all the work, the minimum diameter of the fire mains shall be 6 inches and all other requirements of this document shall be satisfied. The contractor shall furnish and install hydrants to meet the standards of the City of Minneapolis fire marshal. Hydrants shall have integral drains open to granular soil unless groundwater is present during installation. Hydrants shall be painted yellow to distinguish them from red hydrants owned by the City of Minneapolis. The university building official, fire inspection officer, shall approve the design of a private fire-protection water main.
- 4.7. Water service pipe shall be flushed and pressure-tested in accordance with standards established by the Minneapolis Water Department before being put into service. The mains shall be disinfected and tested for chlorine residual in accordance with standards established by the Minneapolis Water Department before being put into domestic service.

5. St Paul Campus

- 5.1. The university owns and maintains all streets and property on the St. Paul campus. Water mains, valves, hydrants, service taps, service manholes, water service pipes, water meters and surface restoration are under the jurisdiction of University Facilities Management, Twin City Water/Sewer Utility Engineer. This document addresses minimum standards for furnishing and installing water mains and appurtenances. Plans for new construction on water works

shall be signed by a registered professional civil engineer, who shall submit them to the Twin City Water/Sewer Utility Engineer for approval before commencing construction.

- 5.2. Water main distribution pipe and water service pipe shall be ductile iron, slip joint with rubber gaskets, mechanical joint fittings, AWWA Class 50 or thicker wall, and lined with concrete mortar. Pipe shall be installed in accordance with manufacturer recommendations and buried a minimum of 5 feet underground. Bends shall be braced with concrete poured against undisturbed soil. Building service pipe 3 inches in diameter or larger shall be installed with a manhole that contains a tee and a valve.
 - 5.3. Water service pipe less than 3 inches in diameter shall be type K copper. Water service pipe less than 3 inches in diameter does not require a manhole at the main. Brass taps, saddles, corporation cocks and curb stops shall be identical to materials used by the Saint Paul Board of Water Commissioners, which has no jurisdiction over water works on the St. Paul campus.
 - 5.4. Hydrants shall be placed to satisfy requirements of the City of Saint Paul fire marshal and the university building official. Water main feeds to hydrants shall be 6 inches in diameter and shall have valves near the hydrant. The contractor shall furnish and install hydrants to meet the standards of the City of Saint Paul Fire Department. Hydrants shall have integral drains open to granular soil.
 - 5.5. Water service pipe shall be flushed and pressure-tested in accordance with standards established by AWWA before being put into service. The mains must be disinfected and tested for chlorine residual in accordance with standards established by the Saint Paul Board of Water Commissioners before being put into service.
6. Water Supply System:
- 6.1. Potable Water
 - 1A. Piping used for water service from the street main to the building that is 3 inches and smaller shall be type K copper. Larger service piping shall be ductile iron with mechanical joints.
 - 1B. All lines above grade shall be hard-drawn copper with all joints assembled using lead-free solder or brazing.
 - 1C. The A/E shall refer to ASTM B32 for solder composition, and to the Minnesota Plumbing Code for type of solder or brazing allowed for potable water piping.
 - 1D. Copper lines buried below slab on grade shall be type K copper. Where copper lines penetrate slabs, provide sleeve and minimum of ½” closed cell pipe insulation for protection.

- 1E. Copper piping shall be continuous systems without iron nipples and fittings.
 - 1F. Dielectric unions shall be used where dissimilar metals are joined together.
 - 1G. The contractor shall conduct a hydrostatic test on all water piping in the presence of the university representative and in accordance with the Minnesota State Plumbing Code prior to covering piping and connecting it to fixtures and equipment. Minimum test pressure shall be 100 psig or one and a half times the maximum working pressure, whichever is greater.
- 6.2. High Purity Water Systems.
- 2A. **PROHIBITED:** A combination of compressed air and nitrogen for testing high-purity water systems.
 - 2B. **PROHIBITED:** Dead legs, except for faucet connections.
 - 2C. Reagent grade 3 water is generally adequate for central building distribution. Reagent grade 3 water, as specified by the College of American Pathologists (CAP) or the National Committee for Clinical Laboratory Standards (NCCLS), is resistive at 25 degrees C of 0.1 meg ohms/centimeter and at a pH between 5 and
 - 2D. The reagent grade 3 central system that feeds a local laboratory water purification system can provide purer water for consumption.
 - 2E. Water in the system shall be circulated at a minimum rate of 5 Fps.
 - 2F. Valves shall be manufactured from the same material as used in the piping systems. Valves shall be ball valves, diaphragm type.
 - 2G. Laboratory faucets for high-purity water service systems shall be silver-plated. Specify Chicago Faucet LC969 or university-approved equal. Stainless steel faucets are acceptable.
 - 2H. All high-purity storage tanks shall be stainless steel, polypropylene, or polyethylene to meet reagent grade 3 standards.
 - 2I. The high-purity water system shall be designed with a bleed valve and shall have an inline disinfecting system when minimal bacteria count in the product water is required. The use of ultraviolet light in systems with a circulation pump is recommended to decontaminate high-purity water.
 - 2J. Polypropylene piping shall be provided for high-purity water systems. Joining shall be thermally fused with fusing irons. Electrically fused joints are permitted only with prior approval from the university. PVC pipe may be used on the inlet side of the water treatment system.

- 2K. The completed piping system shall be tested with nitrogen at one and a half times the operating pressure or 100 pounds, whichever is greater, for two hours. All joints shall be soap-tested.
7. Compressed Air Piping for Building Functions. Laboratory compressed air piping is covered under division 23.
- 7.1. **PROHIBITED:** Non-metallic material (unless specifically designed for compressed air usage and approved by the U of M).
 - 7.2. Air piping shall be hard-drawn copper type K, L, or Schedule 40 galvanized piping.
 - 7.3. Compressed air piping systems shall be tested with air at 125 psi gauge pressure for two hours or one and a half times the maximum working pressure, whichever is greater. Use soap test on all joints.

22 11 16. Domestic Water Piping: See table A and B:

1. Pipe

1.1. Tie-ins to New or Existing Mains

- 1A. **PROHIBITED:** Stub-ins when connecting to new or existing mains.
- 1B. Branch lines up to and including 10 inches in diameter that are at least two sizes smaller than the mains may be tied-in using reducing tees or weldolets.
- 1C. Branch sizes greater than 10 inches in diameter must be tied-in with tees.
- 1D. Connections to piping in university tunnels shall have appropriate offsets to maintain pipe stress within acceptable limits.

2. Steel Pipe

2.1. General

- 1A. Galvanized steel pipe shall be at least minimum standard weight.
- 1B. Standard weight and extra heavy black steel pipe shall be A53B, A106B, A120 or A135 welded or seamless construction as indicated for specific applications.

3. Copper Pipe

- 3.1. **PROHIBITED:** Type DWV and type M copper pipes for potable water.
- 3.2. Type K or L copper pipe shall be specified where copper pipe is applicable.

4. Plastic Pipe

- 4.1. In general, plastic pipes are not allowed. However, in special applications of high purity water, and for lab use, it is permissible. Review the plastic pipe use and get approval by the U of M.
5. Pipe Fittings
 - 5.1. General Requirements
 - 5.2. **PROHIBITED:** Couplings normally furnished with lengths of pipe used to install threaded piping.
 - 5.3. Standard weight steel, malleable or drainage couplings shall be used according to application.
 - 5.4. Specify extruded or wrought copper fittings in copper piping systems.
6. Steel Pipes: Specify 300# black or galvanized steel unions for steel piping systems.
 - 6.1. Specify butt-weld or socket-weld fittings consistent with the piping system. For example, specify standard weight fittings with standard weight pipe. Welding flanges shall be weld neck or slip-on with pressure to match the system as required.
 - 6.2. For takeoffs from black steel piping mains and headers 2-1/2 inches and larger, where pipe reduction is two sizes or more, specify weldolets or sockolets in lieu of reducing weld tees subject to field inspection prior to connection to branch lines. Manifolds must use reducing weld tees.
 - 6.3. Specify isolating/dielectric unions or isolating/dielectric flanges wherever iron and copper or iron and brass piping and equipment are used together in a water piping system. The A/E shall clearly show on drawings all locations for isolating/dielectric unions.

22 012 00. Building Potable-Water Storage Tanks:

1. Storage tanks shall be limited to glass lined steel tanks, stainless steel, polypropylene, and polyethylene. Fiberglass tanks are allowed for DI or RO water storage. All tanks shall be vented to the atmosphere and shall have adequate manholes for cleaning and inspections. All venting shall be designed to protect it from outside contamination.

22 013 00. Building Sanitary/Storm: See table A and B:

1. Below Grade Storm and Sanitary Piping System: Underground soil piping, except corrosive waste piping, shall be regular weight no hub cast iron pipe. No PVC or other plastic piping shall be allowed underground within the buildings.
2. Waste and Vent Piping Systems. These standards allow the use of PVC above ground. The designer shall confirm with the building owner issues relating to much louder sound than the cast iron. The designer shall also allow for fire proofing when penetrating floors,

smoke and fire ratings in the plenums, and expansion of pipes both in the horizontal and vertical layouts. Expansion joints details shall be provided for approval by the U of M

- 2.1. All aboveground waste piping shall be cast iron or PVC.
 - 2.2. All vent piping shall be cast iron or PVC.
 - 2.3. All VTR shall be minimum 4" diameter metal, extending a minimum of 18" above the finished roof. Specify frost-proof jackets on metal vent stacks through the roof. The A/E shall coordinate vent stacks with the roof specification.
3. Roof Drainage Piping: Aboveground roof and storm drainage piping shall be standard weight galvanized steel or cast-iron pipe with no hub fittings. Provide MG couplings for systems subject to pressure. PVC is acceptable for roof drainage with proper expansion and contraction provisions.
4. Chemical Waste Drainage System
- 4.1. **PROHIBITED:** Acid neutralization systems.
 - 4.2. **PROHIBITED:** Neutralization by dilution, with the following exceptions:
 - 2A. Closed combustion high efficiency natural gas burners.
 - 2B. Tankless water heaters
 - 2C. Tankless hydronic boilers
 - 2D. Special conditions as reviewed and approved by the Energy Management.
 - 4.3. The A/E shall consult with the Building Code Department in each case where corrosive waste is disposed.
 - 4.4. Corrosive waste drain and vent systems shall be specified for all laboratories where use of acids or other corrosives is probable. In general, the design and specifications shall be based on borosilicate glass drain line piping with approved couplings. Glass drain lines may be installed underground, providing such piping is completely encased in approved foam plastic envelopes prior to back-filling.
 - 4.5. Polypropylene or PVDF: waste and vent systems may be used in lieu of glass for horizontal runouts not exceeding 60 feet in developed length, subject to the following conditions:
 - 5A. All material furnished shall be fire-retardant and self-extinguishing.
 - 5B. Plastic materials shall penetrate fire-rated floors, walls or partitions using UL-listed penetrations and fire stop materials.

- 5C. The A/E shall review chemical use with the user to ensure compatibility with the piping system specified and chemicals used. For example, the bleach used in dish washing and disinfecting applications has significantly degraded polypropylene pipe.
 - 5D. Prior approval by the Standards Exception Committee is required. The A/E shall present certification by the contractor and the system manufacturer to the Standards Exception Committee prior to work being started.
- 5. All corrosive waste drain and vent systems shall be clearly shown by riser diagrams or equivalent means of identification, indicating by suitable symbols the exact extent of the acid-resistant piping. Diagrams shall be complete enough to show exact terminal fittings.
 - 6. Where long runs of horizontal acid-resistant waste piping are required and subject to expansion and contraction, install expansion provisions and indicate locations. This is in addition to the MN Plumbing code requirements of 25 feet.
 - 7. Where traps are installed, corrosion-resistant tailpieces shall be used.
 - 8. Adequate space shall be provided for servicing traps.
 - 9. Provide a wastewater sampling port at the lowest common collection point.
 - 10. Glass Pipe: Borosilicate glass drain line shall be specified for use in corrosive waste systems and corrosive vent systems. Limited use of specialized plastic pipe may be allowed for dedicated use applications.

22 015 00. General Service Compressed-Air Systems:

- 1. This division only covers compressed air used for building operations. Compressed air for the labs and medical use is covered under division 22 30 00 6.1. All piping shall be metallic, copper type L or schedule 10, 20, 40 stainless steel.

22 030 00. Plumbing Equipment:

- 1. Water Meters
 - 1.1. All meters shall be of the type that conforms to the requirements of the water department of the city or the community supplying water to the project except for the St Paul Campus where the type of meter will be specified by the Facilities Management, Twin City Water/Sewer Utility Engineer.
 - 1.2. Meters 1-1/2 inches and larger shall be rigidly supported 12 inches above the floor on a poured concrete base.
 - 1.3. Spool pieces shall be provided on both sides of meters 3 inches and larger.

2. Floor Drains: Chloraloy or university-approved equal membrane flashing shall extend inches from the clamping ring on all floor drains located in slabs not on grade. For remodeling projects, an approved water proofing method shall be used.
3. Plaza Drains: Plaza drains must be of the type that drains at all levels from the top grate down to the waterproofing, have a non-puncturing clamping ring and can withstand the anticipated superimposed loads.
4. Clean-outs
 - 4.1. **PROHIBITED:** Rubber gym caps, wing nut type or other non-metallic clean-outs. Easily removable fixtures with integral traps shall not be used for cleanouts.
 - 4.2. Clean-outs shall be brass Minneapolis Pattern Type. Clean-outs for corrosive-resistant piping shall be furnished as manufactured for that application. All clean outs shall be placed in accessible locations. Overhead areas are not considered accessible locations.
 - 4.3. All clean-outs that require access through concrete floors shall be installed just below the floor surface with a flush-type clean-out cover level with the floor.
5. Laboratory and Medical Air Compressors
 - 5.1. **PROHIBITED:** Water-cooled, a single pass through the water-cooled system and liquid ring compressors.
 - 5.2. Central compressed air is available for most of the Twin Cities campuses. It shall be used for all labs and controls use and wherever medical grade air is not required. The Minneapolis campus central air is oil free. St. Paul campus central air is through the oil screw compressors with high degree of oil removal. Contact Energy Management for further details.
 - 5.3. Central compressed air systems for the medical air shall consist of two parallel piped compressors, with each one designed to handle 100 percent of the design load and each one fed from a different electric branch circuit or feeder. The compressors shall be installed so that either one can be the lead or lag compressor.
 - 5.4. Depending upon the application, capacity and cost, the compressor that is specified can either be air-cooled or water-cooled. In the case of water cooled, once through water is not permitted.
 - 5.5. Each compressor shall have a dryer that is either refrigerated or desiccant depending upon the application. A desiccant dryer shall be regenerative (absorbing) type.

- 5.6. For maintenance purposes, each dryer shall be isolated by ball valves at both ends.
 - 5.7. The compressor motor shall be highly efficient and air-cooled, and the drive shall be non-geared.
 - 5.8. Air compressors for medical facilities shall comply with the requirements specified in NFPA-99-1, Standards for Health Care Facilities.
6. Laboratory Vacuum Pumps and Medical Vacuum Pumps: Review the application and equipment selection with the owner and the Energy Management prior to the project cost estimating.
- 6.1. **PROHIBITED:** Water-cooled, a single pass through the water-cooled system.
 - 6.2. Laboratory vacuum systems shall be high efficiency without water ring systems. The pumps shall be piped parallel to one another. Each one shall be sized for 100 percent of the load and each one shall be on a separate electric branch circuit.
7. Special Fixtures and Systems
- 7.1. Laboratory Sinks: Laboratory sinks shall be epoxy resin or university-approved equal to match laboratory counter tops. Laboratory sinks shall be complete with borosilicate glass tailpieces and traps. Special plastics tailpieces and traps shall be considered on a case-by-case basis.
8. Services to Laboratory Equipment
- 8.1. The specifications for plumbing work shall specify that all piping, sleeves, valves, stops, sink trim, laboratory bench and fume hood trim, sinks and piping insulation shall be provided. This equipment is required to completely install mechanical services to laboratory benches, sinks and fume hoods. All lab fixtures shall be Chicago Faucet as appropriate for services required or university-approved equal.
 - 8.2. The A/E shall coordinate the plumbing installation design with the laboratory furniture shop drawings. Provisions shall be made in the drawings or in the specifications for minor location adjustments to meet the equipment requirements. These adjustments shall be made before the installation of the plumbing piping systems.
 - 8.3. Services such as hot or cold water, vacuum and gas shall have a valve specified and shown on the drawings. The valves shall be easily accessible after installation of the equipment so that service to the unit may be shut off for maintenance or repair.
 - 8.4. Refer to Division 130010 Laboratories - Emergency Eyewash and Safety Shower Installation.

9. Services to Kitchen Equipment

- 9.1. Refer to Division 130030 - Food Service Construction Guide.
- 9.2. The specifications for plumbing work shall indicate that all piping, sleeves, shutoff valves and pipe insulation to kitchen equipment shall be provided.
- 9.3. The kitchen equipment contractor shall furnish a shop drawing in which the specifications for piping are required to terminate at exact equipment locations.
- 9.4. Domestic Hot Water System:
- 9.5. All tanks, vessels, and all expansion tanks shall have ASME stamp.
- 9.6. Gas fired water heaters are not allowed unless absolutely necessary. These shall be reviewed and approved by Energy Management.
- 9.7. The A/E shall specify instantaneous or semi-instantaneous water heaters using low-pressure steam. All steam to hot water systems shall have double wall heat exchangers. All steam and condensate piping is by division 23. The A/E shall consider using a small diaphragm-style expansion tank to accommodate system expansion. Locate the expansion tank on the discharge pipe of the water heater. The expansion tank shall be equal to Amtrol 12V.

22 31 16. Commercial Domestic Water Softeners:

1. Water softeners, when required shall be package type with a separate brine tank. The brine recharge shall be based on water usage.

22 032 00. Domestic Water Filtration Equipment:

1. Water filtration equipment, when required, shall be able to meet the requirements of the requester and shall have adequate capacity for continuous use.

22 033 00. Electric Domestic Water Heaters:

1. Electric water heaters are allowed where there is no steam available, or the hot water demand is very limited. In the case of an electric water heater, the designer is encouraged to consider an integral water heater with heat pump. Office type buildings with limited showers, a tank type water heater with built-in heat pump is recommended.
2. Electric water heaters shall be three phase 208 or 460 volt with built-in temperature controls and a NEMA 1 disconnect. The water heater shall be equipped with a P/T safety valve piped to the nearest floor drain with proper air gap. Install an ASME expansion tank on the hot water side.

22 040 00. Plumbing Fixtures:

1. General

- 1.1. Quality: Provide fixtures that are free from flaws and blemishes with finished surfaces that are clear, smooth, and bright. Where a surface of a fixture comes in contact with walls, floors and or surfaces of other fixtures, grind the surface flat and true.
 - 1.2. Trim for Standard Fixtures: Provide flare fitting type chromium-plated, brass pipe for all exposed flush, waste, and supply pipes at fixtures. Provide 17-gauge, chromium-plated traps. Provide a flare type stop valve on each water supply to each individual fixture.
2. For lavatories, provide individual stop and check on both cold and hot water. Provide a chromium-plated, flared type flexible riser from the stop valve to the fixture. Offset water supplies on handicapped lavatories to meet ADA requirements. Unless noted otherwise, provide vitreous china and enameled cast-iron fixtures in white. Provide automatic IR (infra-red) sensing faucets and flush valves whenever possible for lavs, urinals and water closets. Automatic faucets and flush valves shall be 110 volt or with easy plug in for user friendly repair and replacement. Battery operated infrared faucets flush valves are only acceptable with prior approval. The batteries life shall be guaranteed for extended period.
3. Plumbing fixtures listed in the following paragraphs are for general-purpose applications. Comparable fixtures with necessary appurtenances shall be shown and specified to meet ADA requirements and other special applications.
4. Supply valves shall be ball type quarter turn on/off. No compression fittings are allowed from the supply valves to the faucets.
5. Lavatory
 - 5.1. Bowl: 20-inch by 18-inch vitreous china, 4-1/2-inch minimum height back, with holes to accept specified faucet. The models shall be American standard, Kohler, Zurn, or university-approved equal. Bowl mounting shall use concealed arm carriers.
 - 5.2. Trim: Chicago Faucet No. 802A with aerator, 802A-317, 895-317, automatic IR sensing mixed temperature faucet, or university-approved equal, 17-gauge drain with 1-1/2-inch tailpiece. Low flow at 0.5 GPM with aerators.
 - 5.3. Supply: Loose key chrome-plated angle stops with checks, 5/8 OD flared type by 3/8 OD flared type. The models shall be Brass Craft, Model SCR19, Model SCR14 or approved equal. No compression fittings are allowed.
 - 5.4. Trap: 1-1/2-inch chrome-plated cast brass P trap with 17-gauge tubing outlet and deep escutcheon. The trap shall have a brass waste connection with slip joint inlet and ground ring chrome-plated brass nut. The models shall be Kohler K-9000 or university-approved equal. Wrap trap and supplies if required to meet ADA standards.

6. Water Closets

- 6.1. Bowl: Wall-hung siphon jet elongated rim with 2-1/8-inch minimum passageway, 1-1/2 inch top spud bowl and china bolt caps. The bowl shall be American Standard, Kohler, Zurn, or university-approved equal.
- 6.2. Floor mounted water closets shall be approved if it is necessary due to space constraints.
- 6.3. Water closets shall be selected for a MaP score of 8,00 to 1,000 at 1.28 gallon per flush.
- 6.4. Valve: Flush valve with vacuum breakers and flush connection to set valve handle above the floor. Valves shall be Sloan No. 115 - 1.5 Royal, Zurn, Kohler, American Standard, automatic IR sensing flush valve, or university-approved equal.
- 6.5. Flush valve design shall be ADA-compliant at universal access installations. Lever handle shall be extended style and mounted on wide side of stall where fixture is universally accessible.
- 6.6. Seat: Black or white, open-front, seatless cover. The seat models shall be Church, Olsonite No. 10 or university-approved equal.
- 6.7. Carrier: Josam, Smith or Zurn for unit furnished.

7. Urinals:

- 7.1. Wall-hung, low-consumption vitreous china, blow out flush action urinal with 1-1/4-inch top inlet, 2-inch back outlet American standard or university-approved equal, with automatic IR sensing flush valve. Refer to the A/E plans for mounting height.
- 7.2. The bowl shall built-in anti-microbial coating and a flush rate of 0.5 gallon per flush. 1/8 gallon per flush is not allowed.

8. Showers

- 8.1. All public showers shall be equipped with individual mixing valves.
- 8.2. Showerheads shall be 1/2-inch chrome-plated with a ball joint and 1.5 gpm flow control. The models shall be Chicago No. 620A-1007 or university-approved equal.
- 8.3. Mixing valves shall have a maximum temperature setting of 115 degrees F. The models shall be Symmons Temptrol S-96-1, S-96-2 or Chicago 1760 pressure-independent, Bradley or university-approved equal.
- 8.4. Chloraloy or university-approved equal membrane flashing at shower drains shall run under entire shower base and turn up 6 inches at edges of shower space.

9. Standard Refrigerated Water Coolers

- 9.1. Specify wall-hung, lead-free, electric water coolers that have a capacity of 8 gallons per hour of 50 degrees F drinking water with 80 degrees F inlet water, while operating at an ambient temperature of 90 degrees F.
- 9.2. The cooler shall be constructed for wall-mounting and suspension to provide open floor space under the cooler.
- 9.3. The cooler shall have a completely hermetically sealed refrigeration system according to current EPA standards that consists of a hermetically sealed air-cooled condensing unit, an evaporator and all connecting piping. The cooler shall be contained in a heavy angle iron frame as one complete and self-contained unit. The entire water cooler, including the self-contained unit and all component parts, shall have a five-year warranty.
- 9.4. The unit shall be encased in easily removable, one-piece stainless-steel housing.
- 9.5. The cooler shall have a one-piece, heavy-gauge polished stainless steel formed top, and a hand-operated bubbler.
- 9.6. Water coolers used at universal access installations shall be of two-tier design and be ADA-compliant.
- 9.7. Specify the style of acceptable covering on cooler sides and front panels.
- 9.8. Water coolers shall have a built-in water bottle filler.

10. Mechanical Room Service Sink

- 10.1. Sink: 24 inches by 20 inches, acid-resistant enamel, cast-iron service sink with 10-inch back and concealed hangers. The models shall be Kohler, K-6718 Bannon or university-approved equal.
- 10.2. Trap: 3-inch trap, enamel inside. Models shall be Kohler K-6673 or university-approved equal.
- 10.3. Rim Guard: Stainless steel. Models shall be Kohler K-8936 or university-approved equal.

11. Mop Sink

- 11.1. Basin shall be Fiat Products MSB-2424, 24-inch by 24-inch by 10-inch-high molded stone basin with a 3-inch factory installed drain and stainless-steel strainer. Provide each mop basin with a vinyl bumper guard, 30-inch high (stainless steel) wall guard, mop hanger, 30-inch flexible hose and hose bracket or university-approved equal.
- 11.2. Provide a Chicago Faucet #897 faucet with vacuum breaker spout, 3/4-inch hose thread, pail hook, adjustable inlets, 369 handles, chrome-plated finish or

university-approved equal. Branch lines feeding the mop sink shall have individual isolation valves.

- 11.3. A separate water supply with approved vacuum breaker and check valves shall be provided for dispensing cleaning chemicals.
- 11.4. Provide a 3-inch floor drain adjacent to each mop basin. Refer to the floor drain section for the standard type of drain.

22 060 00. Gas and Vacuum Systems for Laboratory and Healthcare Facilities:

1. Medical Gas Piping

- 1.1. Compressed air, vacuum, oxygen, nitrous oxide and other medical gas piping shall be designed, specified, installed and tested in accordance with NFPA 99, Standards for Health Care Facilities. The contractor shall submit copies of installer certification documents to the owner's representative for verification of status.
- 1.2. After installation of medical gas piping, but before installation of station outlet valves, lines shall be blown clear with nitrogen.
- 1.3. After installation of station outlet valves, each section of piping shall be subjected to a test pressure one and a half times the maximum working pressure, but in no case less than 150 psi, using nitrogen. This test pressure shall be maintained until each joint has been examined for leakage using soapy water. All leaks shall be repaired, and the section tested again.
- 1.4. A 24-hour standing pressure test shall be made with nitrogen at one and a half times the maximum working pressure, but in no case less than 150 psi, to check the completeness of previous joint tests. After completion of the final standing pressure test, flush the system with the specified medical gas until it reaches at least 99 percent concentration.
- 1.5. Tests on medical gas piping shall be made only in the presence of the A/E and the owner's representative.

22 00 025. Laboratory Vacuum Piping:

1. Laboratory vacuum piping shall be designed, specified, installed, and tested in accordance with NFPA 99, Standard for Health Care Facilities.

22 00 026. Natural Gas Piping:

1. All underground piping and fittings shall be type K copper. Interior piping shall be Schedule 40 black steel pipe or type L copper pipe. Aboveground exterior piping and fittings shall be Schedule 40 galvanized or type K copper. All concealed or inaccessible joints shall be welded or brazed.
2. Unions shall only be used at meters and near equipment. Where required, unions shall be 150 pounds. Low points shall be dripped, and all piping shall be graded to drip points.

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3. Main gas service shall have valves at the service entrance and shall be visible, labeled, and not more than 5 feet above the floor.
4. Provide emergency shut off valves at the entrance to each laboratory. The type of emergency shut off shall be coordinated with the building type and amount of natural gas used. This shall be reviewed by the U of M building codes.
5. The Standards Exceptions Committee shall review all underground piping installation.
6. Natural gas piping systems shall be tested per applicable code. Soap-test all joints. Within the buildings, the natural gas is normally distributed at 2-5 psig.

Table A: Potable Water¹

Piping Materials	Pipe Size	Application	Piping Standards	Fittings Standards	Allowed Valves	Allowed Fittings and Joints	Not Allowed - Pipes, Joints, Fittings, and Valves
Soft annealed copper Type L	1/4" to 3/4"	Above ground, within building	ASTM B88	ASME B16.26	-Lead free bronze NPT 1-piece full port ball valves. -Lead free bronze NPT globe valves for process controls, limited to 1/2" -NSF potable water gaskets	-Lead free flared Fittings only	-OUS made pipe and fittings -Push in fittings -Compression fittings -Gate valves -Zinc alloy fittings and valves
Hard drawn copper Type K, L	1/2" to 2"	Above ground, within building	ASTM B88	ASME B16.182 ASME B16.223 ASME B16.264 ASME B16.515	-Lead free bronze NPT 1-piece full port ball valves. -Lead free bronze NPT globe valves for process controls, limited to 1/2" -NSF potable water gaskets	-Lead Free sweat fittings -Lead free wrought fittings -Lead free push in crimped fittings ² -Lead free flared Fittings	-OUS made pipe and fittings -Split collar grooved couplings -Compression Fittings -Gate valves -Butterfly valves -3-piece ball valve -Zinc alloy fittings and valves
Hard drawn copper Type K, L	2.5" to 3"	Above ground, within building	ASTM B88	ASME B16.182 ASME B16.22	-Lead free bronze NPT 1-piece full port ball valves. -Lead free bronze NPT 3-piece full port ball valves. -NSF potable water gaskets	-Lead free brazed fittings only	-OUS made pipe and fittings -Split collar grooved couplings -Compression fittings -Gate valves -Butterfly valves
Stainless steel 304 schedule 10	4" to 12"	Above ground, within building	ASTM A312 TP304	ASTM A403 ASME B16.910 NSF 61	-Stainless steel Butterfly valves with lugs -NSF potable water gaskets.	-Welded -Brazed	-OUS made pipe and fittings -ASTM A312 TP304L -Split collar couplings ³ -Compression fittings -Split collar rolled grooved couplings
Mechanical Fittings	1" to 4" SS only	Above ground, laboratory environment			-Stainless steel NPT 1-piece full port ball valves	-Pipes: Victaulic or approved equal. -Fittings: NPT only	Press fittings, insert fittings, brass and copper.

¹ Conditional approval of new products prior to bidding on a case-by-case basis.

² Conditional approval on a case-by-case basis based on design circumstances.

³ Conditional approval on a case-by-case basis based on design circumstances.

Table B: Drain Waste and Vent⁴

Piping Materials	Pipe Size	Application	Piping Standards	Fittings Standards	Notes
Cast Iron	2" and up	Above Ground: 2" and up, Sanitary and Storm. Below Ground: 3" and up	ASTM A74 ASTM A888 CISPI 301	ASTM B16.4 ASTM B16.12 ASTM A74 ASTM A888 CISPI 301	OUS made pipes and fittings not allowed.
PVC	1-1/2" and up	Above Ground only. Sanitary and Storm	ASTM D2665 ASTM F891 ASTM F1488 CSA B181.2	ASTM D2665 ASTM F1866	-OUS made pipes and fittings not allowed -PVC is not allowed underground
Stainless Steel 304, 316L	3" and up	Motorized vehicle and corrosive areas. Both Above ground and below ground	ASME A112.3.1	ASME A112.3.1	-OUS made pipes and fittings not allowed -Only 316L allowed below ground
PVDF	2" and up	Both above and below ground	ASTM 1673 CSA B181.3	ASTM 1673 CSA B181.3	-OUS made pipes and fittings not allowed -Pipes and fittings by the same manufacturer
Mechanical Fittings	3" and up	Above ground		Half split fittings with Elastomer gaskets	-OUS made pipes and fittings not allowed -High service areas, garages and parking lots.

END OF DIVISION 22 – PLUMBING

⁴ Conditional approval of new products prior to bidding on a case-by-case basis.