DIVISION 22 – PLUMBING

22 00 00 – PLUMBING GENERAL INFORMATION

A. See Division 33 for information on water, sanitary, and stormwater utility systems.
B. See Division 33 for information on utility water meters.

22 05 00 – COMMON WORK RESULTS FOR PLUMBING

A. Meters (Non-Utility) and Gages for Plumbing Piping

1. Acceptable Products:
   a. Meters: None listed.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Provide pressure-temperature taps at each pump suction and discharge.
   b. Provide ball valve at all gages for removal under operation.
   c. Alcohol filled or dial thermometers are acceptable. Thermometers to be located in matching thermal wells. Direct insertion type thermometers are prohibited.
   d. Provide thermometers at equipment on both supply and return for hot water systems.

B. General-Duty Valves for Plumbing Piping

1. Acceptable Products:
   a. Ball Valves: Apollo (Made in the USA) or approved equal.
   b. Butterfly Valves: Keystone, Apollo, Watts, or approved equal.
   c. Gate Valves: Gate valves are only allowed as a part of a backflow preventer assembly. See backflow preventers.

2. Products Not Allowed
   a. Ball Valves: Ball valves manufactured outside of the United States are not allowed.

3. Discussion
   a. Valves in both domestic and industrial water systems shall be rated for potable water use.
   b. Valves for isolating separate wings, floors, laboratory rooms, toilet rooms, machinery rooms and other natural subdivisions of building sections shall be provided on water piping systems.
c. Isolation valves shall be located for ready access (for example, not over an office, not behind a water closet, not within a restricted area). Access doors shall be provided for all valves located behind walls or above hard-lid ceilings. Doors shall be of sufficient size for operation and maintenance of the valves.

d. Ball valves shall be full port.

e. Ball valves shall be used for piping and connections 2” and smaller. Butterfly valves shall be used for piping and connections larger than 2”.

f. Valves adjacent to equipment shall have unions or flanges provided to allow for removal.

g. All valves shall be numbered with a brass tag and a schedule shall be submitted with valve number, purpose, location, and normal operating position. Valve schedule shall be incorporated into the as-built drawings, mounted in a protected form in mechanical rooms, and in the O&M manual. Remodel projects shall add and update valve schedules.

h. All valves shall be mounted so operation is possible without interference from pipes, pipe hangers, pipe insulation, walls, etc. All valves on horizontal piping shall be mounted with the stem at the centerline of pipe or above.

i. Isolation valves shall not be used for balancing and balancing valves shall not be used for isolation.

C. Identification for Plumbing Piping and Equipment

1. Acceptable Products:
   a. (future)

2. Products Not Allowed
   a. (future)

3. Discussion
   a. (future)

22 07 00 – PLUMBING INSULATION

A. Insulation for Plumbing Piping

1. Acceptable Products:
   a. Mansville, Knauf, Manson, or Owens Corning.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Domestic and industrial cold water lines: 1/2” minimum fiberglass insulation with continuous vapor barrier.

   b. Domestic and industrial hot water lines: Meet minimum thickness per current version of ASHRAE 90.1 incorporated in code.
c. Roof drain lines: 1/2" minimum thickness fiberglass insulation.

d. Install cal-sil insert with metal hanger shield at all piping hangers and supports.

e. If ball valves will be insulated, a 2 inch handle extension with a protective sleeve shall be provided that allows operation of valve without breaking the vapor seal.

f. Piping in areas where damage may occur shall have protective aluminum or other suitable jacket over insulation.

g. Pipes requiring insulation shall have continuous insulation and jacketing (if relevant) through wall and floor penetrations.

22 08 00 – COMMISSIONING OF PLUMBING

A. Testing of Sweat and Solder Joints for Plumbing Piping

1. All copper sweat and solder joints are subject to quality control testing by non-destructive means (e.g. ultrasonic, x-ray). The University shall employ a third-party firm to perform the testing. When performing the tests, the following procedures shall be followed:

a. Sampling for the first round of testing is to be done at a 90/10 confidence and precision level, with an assumed coefficient of variation of 0.5. If no deficiencies are identified, then no further testing is required.

b. If deficiencies are identified in the first round, those joints shall be replaced. A second round of testing on random joints, chosen by the University, will be tested at an equal or greater sample size to the initial test. If no additional deficiencies are identified, then no further testing is required.

c. If deficiencies are identified in the second round, those joints shall be replaced and every joint in the system shall be tested.

d. The contractor shall be responsible for all labor, material, and travel expenses involved in any of the re-inspection, retesting, and replacements.

B. The Plumbing Contractor shall be required to clean, disinfect and test all domestic hot and cold water systems, including fire systems connected to the domestic water systems. The procedure shall follow ANSI/AWWA Standard C651, most recent edition. For buildings already occupied, the procedure shall be modified as required to accommodate the occupants.

C. The Plumbing Contractor shall notify Facilities Management through University Representative when disinfection and testing are complete. Disinfection report shall be submitted to both University Representative and Facilities Management.

D. Super-chlorinated water shall be de-chlorinated before discharge.

E. A disinfection report shall be included in the O&M manuals.

F. Floor drains, other drain fixtures and all drain piping exposed during construction shall be covered and protected from debris entering the pipes. The drain system shall be flushed in presence of University Representative at the end of construction and cleaning provided by contractor if blockage exists.

G. Backflow prevention devices shall be tested, as part of the Code Inspection process, by a certified Cross Connection Control Technician possessing a valid certification from the American Society of Sanitary Engineering (ASSE), the America Backflow Prevention Association (ABPA) or the Association of Boards of Certification (ABC). Tests shall be in
conformance with the "Colorado Cross-Connection Control Manual" published by the Colorado Department of Public Health and Environment.

H. Test reports for all backflow prevention devices shall be included in O&M manuals at the completion of project.

I. Backflow prevention devices shall be tested again at 11 months from start of warranty period by the contractor according to the requirements listed above. Test reports shall be submitted to the Facilities Management-Plumbing Shop supervisor through the University Representative. Repair or replacement of devices which fail the test is the responsibility of the contractor.

J. Hot Water Recirculation system balancing valves shall be included in the TAB contractor scope of work and final report.

K. Factory start-up shall be included for water heaters and heat exchangers, sump pumps, and sewage ejectors.

**22 10 00 – PLUMBING PIPING**

A. Water service entry arrangement shall consist of: full port isolation valves, strainers, utility meter, and reduced pressure backflow prevention devices in parallel. See Drawing Appendix.

B. A separated Industrial Water system, both hot and cold, shall be installed for service to laboratory sinks and hoods.

C. The following information contained in "Domestic Water Distribution" applies also to separated Industrial Water systems.

D. Equipment cooling with treated water (domestic or industrial) is prohibited. A process cooling system shall be proposed in lieu of domestic water cooling. However, use of treated water from a separated industrial water system as an emergency back-up to a primary process cooling system is allowed.

E. Cross-connection conditions are prohibited and backflow prevention devices shall be used in accordance with the "Colorado Cross-Connection Manual" and the "City of Fort Collins Cross Connection Control Manual" to prevent and address cross connection contamination conditions.

F. The domestic water piping distribution system shall provide a hot and cold water feed to each lavatory. Some specific applications and projects may be evaluated to determine if a single, tempered water supply to each fixture is appropriate (e.g. specific lab fixture).

G. All hot water recirc piping shall be routed down the wall to counter level.

H. Chemical, carcinogenic, biological or other toxic or hazardous wastes shall not be put into the sanitary sewer. They shall be disposed of by proper methods as approved by Environmental Health Services and Facilities Management through the University Representative on a case-by-case basis.

I. General lab waste at sinks and hoods, unless approved otherwise, shall drain to an acid-waste and vent piping system. See section 22 66 00 – LAB ACID-WASTE SYSTEMS.

J. Stormwater drainage must go into its own drainage system. This includes surface runoff, rain, snowmelt, and groundwater. Discharge of uncontaminated groundwater and stormwater to the sanitary sewer system is prohibited. Coordinate with the University Representative to ensure all discharges are conveyed to the appropriate system and any required permits are obtained.
K. Elevator sump pumps intended to pump the discharge of fire sprinklers must discharge to the sanitary sewer. Oil mender type pumps are prohibited in this situation. Elevator sump pumps in an elevator pit with continuous or periodic groundwater intrusion must discharge to the storm sewer system via an oil mender type pump. Consult Facilities Management via the University Representative for proper application by elevator type.

L. Building water, sanitary and storm sewer pipes buried under structure shall be laid in on firm, undisturbed or compacted soil with a 6 inch bed of sand or 1/4 inch gravel below and above piping. Compaction tests shall be required when excavation removes soil below piping bed.

22 11 00 – DOMESTIC WATER DISTRIBUTION

A. Domestic Water Piping
   1. Acceptable Products:
      a. 2" and smaller: Type-L copper with sweat fittings.
      b. Larger than 2": Type-L copper with soldered fittings.
   2. Products Not Allowed
      a. Grooved, push-to-connect, or press-joined systems of any kind.
      b. PVC, CPVC, PEX, HDPE, or other plastic piping systems.
   3. Discussion
      a. None listed.

B. Domestic Water Piping Specialties – Backflow Preventers
   1. Acceptable Products:
      a. Reduced pressure principal devices: Apollo, Conbraco, Febco, Wilkins/Zurn.
      b. Double check devices: Conbraco, Febco, Watts, Wilkins/Zurn.
   2. Products Not Allowed:
   3. Discussion
      b. Reduced pressure backflow prevention devices shall be installed for all main water services to University buildings, except residential buildings less than 40-feet in height.
      c. Backflow prevention devices shall be installed on fire protection systems, make-up water to all heating and cooling systems, irrigation systems, industrial water systems, and process cooling applications (emergency back-up only) in conformance with the "Colorado Cross-Connection Control Manual" published by the Colorado Department of Public Health and Environment.
d. Water piping systems must be arranged and backflow prevention devices installed so that back siphonage or backflow into domestic systems is not possible.

e. Any water discharging through a faucet to which a hose can be attached must be considered to be potentially hazardous and shall require an atmospheric vacuum breaker.

f. Redundant backflow prevention devices shall be installed in parallel at the main water service to each building, except residential buildings less than 40-feet in height. Each device shall be sized to handle half the building’s full load. See Appendix A detail M-21.

g. Outdoor applications shall be enclosed within a University-approved, insulated enclosure with an integral electric heater. Heat tape is not an acceptable alternative to enclosure or heater.

h. Backflow prevention devices are not permitted inside of fume hoods.

i. Backflow prevention devices shall be installed in accordance with the Colorado Cross Connection Control Manual’s recommended minimum clearances (12-inches above the floor, 36-inch clearance above the device, 12-inch out from wall on back side, and 24-inch clearance in front of test cocks), no higher than 5 feet above floor unless permanent platform is provided.

C. Domestic Water Piping Specialties – Hose Bibbs and Wall Hydrants

1. Acceptable Products:
   a. Woodford, Zurn, Josam, or approved equal.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Freeze-proof, key-operated wall hydrants shall be provided at outside locations near entrances to a building for wash-down and Outdoor Services crew use. These shall be located as inconspicuously as possible consistent with accessibility. Provide separate shut off valve inside.

   b. Hose bibbs shall be provided at all major equipment in mechanical rooms, on rooftops, or exterior to the building to facilitate wash-down.

   c. All wall hydrants and hose bibbs shall have integral backflow preventers.

   d. Restrooms should have a key-operated wall hydrant or hose bib for Building Services cleaning work.

D. Domestic Water Piping Specialties (Vacuum Breakers, PRV’s, Mixing Valves, Strainers, Shock Absorbers)

1. Acceptable Products:
   a. None listed.

2. Products Not Allowed
3. Discussion
   a. Shock absorbers shall be placed in water lines to equipment that might produce water hammer. Isolation valves shall be installed at shock absorbers.

E. Domestic Water Pumps
   1. Acceptable Products:
      a. Domestic water circulation pumps: Bell & Gossett, Taco, Grundfoss, or approved equal.
   2. Products Not Allowed
      a. Domestic water circulation pumps: Amtrol (Thrush).
   3. Discussion
      a. Circulation pumps shall include all bronze construction with optional stainless steel body, ground and polished steel shaft with integral thrust collar, horizontal arrangement, sleeve bearings, oil-lubricated, mechanical carbon face seal with ceramic seat, self-aligning flexible coupling, non-overloading, open-drip proof motor with built-in thermal overload protection, 125 psig working pressure, 225°F water temperature.
      b. "Quiet" operation shall be specified for pumps outside of mechanical rooms where noise is a consideration.
      c. Pump speeds shall be limited to nominal 1800 rpm for plumbing applications.

22 12 00 – POTABLE WATER STORAGE TANKS
   A. Potable Water Pressure Tanks
      1. Acceptable Products:
         a. None listed.
      2. Products Not Allowed
         a. None listed.
      3. Discussion
         a. In general, storage vessels for potable hot or cold water are not allowed. An exception is made for on-demand water heaters and pressure tanks installed in tandem with building booster pumps and pumping stations.
         b. Pressure tanks are to be sized to mitigate short-cycling at domestic water pumping stations. Pressure tanks are not to be sized to allow for excess storage.

22 13 00 – SANITARY SEWERAGE
   A. Sanitary Waste and Vent Piping
      1. Acceptable Products:

2. Products Not Allowed
   a. Drain, waste and vent interior piping - ABS and galvanized piping.
   b. No piping made outside of the USA is permitted.

3. Discussion
   a. None listed.

B. Sanitary Waste Piping Specialties – Cleanouts
   1. Acceptable Products:
      a. None listed.
   2. Products Not Allowed
      a. No cleanouts made outside of the USA are permitted.
   3. Discussion
      a. Interior accessible cleanout caps and plugs will be located such that they can be
         removed without damaging the floor or floor covering.
      b. An additional interior cleanout shall be located above the flood rim level of the fixture.
      c. All cleanouts exterior to the building will be two-way type, to permit cleaning in both
         directions. Plugs shall be lubricated at installation.

C. Sanitary Waste Piping Specialties – Floor Drains
   1. Acceptable Products:
      a. Trap Sealing Devices: ProSet Trap Guard, Sure Seal Trap Sealer, or approved equal.
   2. Products Not Allowed
      a. Trap “primers” of any kind.
   3. Discussion
      a. All restrooms shall have floor drains with positive slope to the drain. The trap should
         be 3 inches minimum in size to help keep it from drying out.
      b. Floor drains located near backflow prevention devices shall be sized according to the
         "Colorado State Cross Connection Control Manual" procedure.
      c. All floor drains shall be protected by an evaporation resistant sealing device.

D. Sanitary Waste Interceptors
   1. Acceptable Products:
      a. None listed.
   2. Products Not Allowed
3. Discussion

a. Kitchen grease traps are required at each building providing food services. Traps shall be located for easy access and servicing, preferably outside, and properly vented.

E. Sanitary Waste Separators

1. Acceptable Products:
   a. None listed.

2. Products Not Allowed
   a. No separators made outside of the USA are permitted.

3. Discussion
   a. None listed.

F. Sanitary Waste Pumps and Pump Stations

1. Acceptable Products:
   a. Submersible Sump Pumps: Weil-McLain or approved equal.

2. Products Not Allowed
   a. None listed

3. Discussion
   a. Specifications shall include cast iron body and impeller, stainless steel shaft, factory-sealed oil-lubricated ball bearings, ceramic mechanical seal, perforated steel strainer, hermetically sealed capacitor-start motor with built-in overload thermal protection.
   b. Provide 20 feet of 3-conductor PVC cord and molded grounding plug.
   c. Controls shall include float-operated mercury switches with duplex control panel in NEMA-3R enclosure with high water alarm with flashing light and bell, seal failure alarm with auxiliary contacts for connection to BAS.
   d. Sump pump operations shall have high water alarms connected to Building Automation System.
   e. Sump pump controls for duplex systems shall automatically alternate lead-lag operation between pumps for equal run time.
   f. See Drawing Appendix for sump pump piping arrangement.
   g. All sanitary sump pumps serving floor drains located in boiler rooms shall be selected for high temperature service (200°F).

G. Septic Tanks

1. Acceptable Products:
   a. (future)
22 14 00 – STORM DRAINAGE

A. Storm Drainage Piping
   1. Acceptable Products:
      a. Satisfy current adopted code.
   2. Products Not Allowed
      a. No piping made outside of the USA is permitted.
   3. Discussion
      a. None listed.

B. Storm Drainage Piping Specialties
   1. Acceptable Products:
      a. (future)
   2. Products Not Allowed
      a. (future)
   3. Discussion
      a. (future)

C. Storm Drains – Roof Drains, Area Drains, and Trench Drains
   1. Acceptable Products:
      a. None listed.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Roof drains or drains located in outside areaways, not subject to regular foot traffic, shall be of the type to minimize clogging with leaves or other debris.

D. Storm Sump Pumps and Pump Stations
   1. Acceptable Products:
      a. Sump Pumps for Elevator Service: Stancor Oil-Minder or approved equal.
b. Submersible Sump Pumps for Storm or Groundwater Service: Weil-McLain, Crane, AMT, or approved equal.

2. Products Not Allowed
a. None listed.

3. Discussion
a. Specifications shall include cast iron body and impeller, stainless steel shaft, factory-sealed oil-lubricated ball bearings, ceramic mechanical seal, perforated steel strainer, hermetically sealed capacitor-start motor with built-in overload thermal protection.

b. Provide 20 feet of 3-conductor PVC cord and molded grounding plug.

c. Controls shall include float-operated mercury switches with duplex control panel in NEMA-3R enclosure with high water alarm with flashing light and bell, seal failure alarm with auxiliary contacts for connection to BAS.

d. Sump pump operations shall have high water alarms connected to Building Automation System. See Division 25 – Integrated Automation.

e. Sump pump controls for duplex systems shall automatically alternate lead-lag operation between pumps for equal run time.

f. See Drawing Appendix for sump pump piping arrangement.

22 30 00 – PLUMBING EQUIPMENT

A. Hot water design conditions shall conform to current code. Higher temperature hot water needed for dishwashers, etc. shall be attained by booster heating units furnished as part of the equipment.

B. Mixing valves shall not be used on any faucets.

C. Mixing valves may be allowed where “hands-off” operation of the faucet is required. This application shall be approved by Facilities Management through the University representative.

D. Identification of new equipment shall follow the pattern of existing equipment for retrofits or remodels.

E. All equipment shall have isolation valves on all piping to and from the equipment.

F. A strainer shall be installed in all piping upstream of equipment.

G. Pipe connections to equipment shall have adequate allowance for movement and vibration. Connections shall be supported such that the weight is not carried by the equipment.

H. Water heaters shall have floor drains installed in the area. Elevated water heaters shall have drip pans installed with indirect drain pipes to floor drains or other drain fixtures.

22 32 00 – DOMESTIC WATER FILTRATION

A. Water sediment or chlorine filtration devices on domestic water service are prohibited.

22 33 00 – ELECTRIC DOMESTIC WATER HEATERS

A. Point-of-Use Electric Water Heaters
PART III - CSU TECHNICAL STANDARDS  
DIVISION 22 – PLUMBING

1. Acceptable Products:
   a. E-Max or approved equal.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. These units shall be point-of-use only.

B. Instantaneous Tankless Electric Water Heaters
   1. Acceptable Products:
      a. Hubble or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Units shall be commercial grade. Residential grade units are not allowed.

C. Tank-Type Electric Water Heaters
   1. Acceptable Products:
      a. Hubble, Rheem, AO Smith, Bradford White, or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Units shall be commercial grade. Residential grade units are not allowed.

22 34 00 – NATURAL GAS-FIRED DOMESTIC WATER HEATERS

A. Instantaneous Tankless Gas Water Heaters
   1. Acceptable Products:
      a. Hubble or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Units shall be commercial grade. Residential grade units are not allowed.

B. Gas-Fired Water Heaters
   1. Acceptable Products:
a. Hubble, Rheem, AO Smith, Bradford White, or approved equal.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Units shall be commercial grade. Residential grade units are not allowed.

### 22 35 00 – DOMESTIC WATER HEAT EXCHANGERS

#### A. Domestic Instantaneous Steam-to-Hot Water Heat Exchangers

1. Acceptable Products:
   a. Leslie Constantemp from Leslie Controls, Inc., Micro-Mix II from Graham, or Flo-Rite-Temp from Armstrong.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Where steam is available, the domestic water heating shall use instantaneous steam heat exchangers.
   b. Storage tank systems with steam coil are prohibited.
   c. Instantaneous heaters shall have feedforward control. Selection shall be based upon 2-15 psig inlet steam, ductile iron shell with single wall copper or stainless steel coil heat exchanger. See Drawing Appendix for piping arrangement.
   d. Instantaneous heaters shall be floor mounted on custom fabricated frames made of 1-1/2 inch angle iron as shown in See Drawing Appendix for Leslie Water Heater Stand.
   e. Exchangers shall be single wall if the building is connected to the Main Campus steam utility. Treatment chemicals used for steam in this utility are FDA approved.

#### B. Domestic Instantaneous Heating Water-to-Hot Water Heat Exchangers

1. Acceptable Products:
   a. Aerco Smartplate or approved equal.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Exchangers shall be double wall construction.
   b. Controller shall be BACNet compatible.

### 22 40 00 – PLUMBING FIXTURES

### 22 42 00 – COMMERCIAL PLUMBING FIXTURES
A. Water Closets and Urinals
   1. Acceptable Products:
      a. American Standard, Kohler, or Zurn.
   2. Products Not Allowed
      a. Toto.
   3. Discussion
      a. All vitreous fixtures shall be of a quality known commercially as 'Twice-Fired Vitreous China'.
      b. Water closet bowls shall meet a minimum MAP score of 1,000 grams.
      c. Waterless urinals are prohibited.
      d. All water closets shall be wall mounted or wall hung. Floor mounted fixtures are prohibited.

B. Lavatories and Sinks
   1. Acceptable Products:
      a. Lavatories: Bradley Verge L-Series or approved equal.
      b. Laboratory Sinks/Tubs: Dura Top, Just, Zurn, American Standard, Chicago, Kohler, or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. All vitreous fixtures shall be of a quality known commercially as 'Twice-Fired Vitreous China'.
      b. All enameled ware shall be cast-iron with 'Acid-Resisting Enamel'. Fixtures shall be complete as described in the manufacturer's catalog.
      c. All lab sinks and tubs shall be listed as chemical resistant. Acceptable materials are stainless steel and epoxy. Lab sinks and tubs that are integral to the casework are not allowed.

C. Showers
   1. Acceptable Products:
      a. None listed.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
a. All showers shall be third party certified.

b. Shower pans shall include a membrane installed underneath.

c. Shower rooms shall have tempering valves for domestic hot and cold water. A faucet with hose thread spout and key handles for building services cleaning work shall be connected to the tempered water supply.

D. Disposals

1. Acceptable Products:
   a. InSinkErator Badger or approved equal.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Allen wrench shall be left with unit.

E. Faucets and Trim

1. Acceptable Products:
   a. Lavatory Faucets: American Standard, Kohler, Zurn or Chicago.
   b. Laboratory Faucets: American Standard, Kohler, Zurn, Chicago or T&S.
   c. Trim: American Standard, Kohler, Zurn, Chicago, or approved equal.

2. Products Not Allowed
   a. Lavatory Faucets: Toto.
   b. Laboratory Faucets: Toto.
   c. Trim: Toto.

3. Discussion
   a. Include integral backflow prevention devices on all laboratory faucets.
   b. All faucets shall be manually operated. No automatic devices (e.g. IR) are allowed.
   c. Faucets shall be sized for 0.5 gpm at 80 psig.
   d. All lavatory faucets shall have four or eight inch center spread. Eight inch center spreads are allowed for laboratory, food service or custodial sinks.
   e. All faucets should have ¼ turn service stop valves that are easily accessible. Provide access panels where needed.

F. Flushometers

1. Acceptable Products:
   a. Flushometer Valves: Sloan or Zurn only.
2. Products Not Allowed
   a. Toto.

3. Discussion
   a. All flushometers shall be manually operated. No automatic devices (e.g. IR) are allowed.
   b. Water closet flushometers shall be 1.28 gallons per flush.
   c. Urinal flushometers shall be 1/8 gallon per flush.
   d. All flushometers should have ¼ turn service stop valves that are easily accessible. Provide access panels where needed.

22 45 00 – EMERGENCY PLUMBING FIXTURES

A. Emergency Showers
   1. Acceptable Products:
      a. Bradley, Haws, or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Shall meet ANSI standards.

B. Eyewash Stations
   1. Acceptable Products:
      a. Bradley, Haws, Eyepod, or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Shall meet ANSI standards.

C. Emergency Fixture Water-Tempering Equipment
   1. Acceptable Products:
      a. Bradley, Leonard, Simmons, or approved equal.
   2. Products Not Allowed
      a. None listed.
   3. Discussion
      a. Shall be easily accessible.
22 47 00 – DRINKING FOUNTAINS AND WATER COOLERS

A. Drinking Fountains

1. Acceptable Products:
   a. Water Coolers: Elkay Model VRC8S or approved vandal-resistant equal.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Mechanically cooled drinking fountains shall be self-contained wall mounted type drinking water coolers. The cooler shall have a minimum cooling capacity of 6 gallons per hour of 50°F drinking water at the inlet water and room ambient temperatures of 80°F with adjustable water temperature control. Water coolers shall be equipped with handicapped fittings and be located according to ADA requirements. Care shall be taken to specify coolers with basins and spouts to minimize dripping, etc. on floor.
   b. Water coolers shall have an isolation valve located above the ceiling in an accessible location.
   c. The design of multiple water coolers shall include an evaluation into the use of a single refrigeration cooling system with multiple water cooler outlets.
   d. Water coolers shall not include a filter, either integral or after-market. Filters are prohibited.

22 60 00 – GAS AND VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

22 61 00 – COMPRESSED AIR SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Compressed Air Piping

1. Acceptable Products:
   a. (future)

2. Products Not Allowed
   a. (future)

3. Discussion
   a. Piping systems shall be zoned appropriately and be provided with zone isolation valves.
   b. Compressed air piping should be sized on the basis of number of outlets, using a figure of 0.5 cfm at 30 psig per outlet. Diversity must be determined by the designer. System loss should not exceed 5 psig loss at estimated peak demand.
   c. See Drawing Appendix for process compressed air supply piping arrangements.

B. Compressed Air Equipment

1. Acceptable Products:
PART III - CSU TECHNICAL STANDARDS

DIVISION 22 – PLUMBING

a. (future)

2. Products Not Allowed
   a. (future)

3. Discussion
   a. A building duplex compressor will be used as the source of process compressed air.
   b. Process air compressors shall be selected to operate with a receiver pressure of 125 to 150 psig with pressure reducing valve to the designated system operating pressure. Install a pressure relief valve on all reduced pressure systems, set for 25 psig over reduced pressure.

22 62 00 – VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Vacuum Piping
   1. Acceptable Products:
      a. (future)
   2. Products Not Allowed
      a. (future)
   3. Discussion
      a. Piping systems shall be zoned appropriately and be provided with zone isolation valves.
      b. Vacuum piping should be sized on the basis of inlets. Use a figure of 1 cfm per outlet and 40 percent simultaneous use for typical laboratory rooms.
      c. Friction loss should not exceed 5 inches of mercury column drop at estimated peak demand. The above should be modified to meet special conditions and types of rooms or service.

B. Vacuum Equipment
   1. Acceptable Products:
      a. Vacuum Pumps: Nash or equal.
   2. Products Not Allowed
      a. (future)
   3. Discussion
      a. Vacuum pumps shall include conical porting, liquid rings, one piece body and a shrouded rotor. Pumps equal to or larger than 15 hp shall operate at 1200 rpm. Flat plate porting is not permitted because it uses more domestic water.

22 63 00 – GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Natural Gas Piping: See Section 23 10 00 - Facility Fuel Systems
22 66 00 – ACID-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Lab Acid-Waste and Vent Piping
   1. Acceptable Products:
      a. Enfield Industrial Corp., Orion, or Zurn.
   2. Products Not Allowed
      a. Pyrex or other glass pipe.
   3. Discussion
      a. Pipes shall be acid resistant, flame-retardant polypropylene pipe. Below grade pipes shall be Schedule 80 with heat fusion joints.
      b. Above grade pipes shall be Schedule 40 with heat fusion joints for inaccessible fittings and mechanical joints for accessible fittings.

B. Lab Acid-Waste Tanks
   1. Acceptable Products:
      a. (future)
   2. Products Not Allowed
      a. (future)
   3. Discussion
      a. Treatment and handling of acid wastes shall be discussed with Facilities Management Engineering through the University Representative to determine the best neutralization configuration.
      b. All neutralization shall be accomplished at a central tank system, outside of the building, located in a dedicated vault. Vault lids shall be placed such that all equipment is accessible and removable.
      c. Limited point of use neutralization is allowed upon approval of Facilities Management Engineering.

22 67 00 – PROCESSED WATER SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Purified Water Piping
   1. Acceptable Products:
      a. Distilled Water: PVC, Grade 1, Type 1, Schedule 80, unplasticized material equal to MFG Celenesse Type 1 (formerly Cabot).
      b. RO Water: Unpigmented, natural polypropylene conforming to ASTM D4101 with thermal welded fittings and mechanical joints.
      c. DI Water: Unpigmented, natural polypropylene conforming to ASTM D4101 with thermal welded fittings and mechanical joints.
   2. Products Not Allowed
PART III - CSU TECHNICAL STANDARDS

DIVISION 22 – PLUMBING

a. None listed.

3. Discussion
a. For higher delivered distilled water quality requirements, other piping materials may be necessary. The piping distribution system shall be gravity feed and include accessible isolation valves at major branches and appropriate gooseneck faucets or spigots at laboratory benches.
b. For applications that require higher quality deionized (DI) water, other materials may be needed. The University Representative must approve any material substitutions with the recommendation of the deionized water vendor.
c. DI water piping distribution systems shall include accessible isolation valves before and after all components and at major branches, and appropriate gooseneck faucets at laboratory benches.
d. Any metal components in DI water piping shall be 316 Stainless.

B. Purified Water Equipment

1. Acceptable Products:
   a. Distilled Water: Coordinate with vendor.
   b. RO Water: Coordinate with vendor.
   c. DI Water: Coordinate with vendor.

2. Products Not Allowed
   a. None listed.

3. Discussion
   a. Distilled water systems may be connected to existing stills. Check with Facilities Management Plumbing Shop through the University Representative for existing capacity information.
   b. Stills may be steam or electric driven depending upon the capacity demand by the user and availability of steam.
   c. Utilities shall be provided by the project to the still and shall include domestic cold water and steam or electric power.
   d. Installation of deionized and reverse-osmosis water systems is to be included in the scope of the project. Service to these systems, after acceptance, is performed by an outside vendor for the University under existing purchase order contracts. Installation shall be performed by this same service vendor. Vendor contact information is available from the University Representative.
   e. The quantity and quality of the deionized water shall be established by the user in cooperation with the vendor through the University Representative. Design requirements shall be coordinated through these parties through the University Representative. All deionized water systems shall conform to Clinical and Laboratory Standards Institute (CLSI, formerly NCCLS) guideline C3-A4. A copy of this guideline is available from Facilities Management Utilities Services Group.
f. For applications that are susceptible to microorganisms and their byproducts (e.g. pyrogens and endotoxins), small, point-of-use systems shall be used to minimize the possibility of contamination from biofilms in the piping system. Additional components, such as ultrafiltration or reverse osmosis units may also be required. Where centralized systems are acceptable, the piping shall be configured in a closed loop with circulation to maintain the water velocity at 6 ft/sec or greater. Branches shall be fitted with appropriate flow control and metering devices. Piping systems shall be configured so as to minimize dead legs.

g. Utilities shall be provided by the project to the deionized system and shall include domestic cold water and an electrical power outlet. For centralized systems, power for circulating pumps, sterilizers and controls will be required.