

PART III – CSU FACILITIES PLANNING, DESIGN AND CONSTRUCTION STANDARDS

DIVISION 22 – PLUMBING

Please also refer to “Part IV – REGULATORY REQUIREMENTS” for additional requirements.

Housing and Dining Facilities (HDS) has adopted amendments for all HDS facilities. Confirm applicable standards with Project Representative on a per Project basis. Refer to HDS amendments here – <https://housing.colostate.edu/about/construction/>.

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22 00 00 – GENERAL INFORMATION

- A. Refer to Division 33 – Utilities for information regarding Water, Sanitary, and Stormwater Utility Systems.
- B. Refer to Division 33 – Utilities for information regarding utility water meters.
- C. Division 22 – Plumbing is applicable to Plumbing Systems within buildings and facilities.

22 05 00 – COMMON WORK RESULTS FOR PLUMBING

A. Meters (Non–Utility) and Gauges for Plumbing Piping:

- 1. Acceptable Products:
 - a. Meters:
 - i. 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 gauges for removal under operation.
 - c. Alcohol filled or dial thermometers are acceptable.
 - i. Thermometers to be located in matching thermal wells.
 - ii. 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:
 - i. Apollo
 - ii. Or approved equal
 - b. Butterfly Valves:
 - i. Keystone
 - ii. Apollo
 - iii. Watts
 - iv. Or approved equal
 - c. Gate Valves:
 - i. Gate valves are only allowed as a part of a backflow preventer assembly.
 - ii. Refer to backflow preventers.
 - d. Balance Valves:
 - i. Bell & Gossett
 - ii. Taco
 - iii. Flow Design

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iv. Armstrong

2. Products not Allowed:

- a. None listed

3. Discussion:

- a. Valves in both Domestic and Industrial Water Systems shall be rated for domestic 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 in all Domestic and Industrial 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).
 - i. Access doors shall be provided for all valves located behind walls or above hard-lid ceilings.
 - ii. 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.
- f. Butterfly valves shall be used for piping and connections larger than 2".
- g. Valves adjacent to equipment shall have unions or flanges provided to allow for removal.
- h. All valves shall be numbered with a brass tag and a schedule shall be submitted with valve number, purpose, location, and normal operating position.
 - i. Valve schedule shall be incorporated into the As-Built Drawings, mounted in a protected form in mechanical rooms, and in the O&M Manual.
 - ii. Remodel projects shall add and update valve schedules.
 - iii. All valve locations shall be shown on As-Built Record Drawings.
- i. All valves shall be mounted so operation is possible without interference from pipes, pipe hangers, pipe insulation, walls, etc.
 - i. All valves on horizontal piping shall be mounted with the stem at the centerline of pipe or above.
- j. 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
- b. Knauf
- c. Manson
- d. Owens Corning

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2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Both domestic and industrial cold and hot water lines shall be insulated with fiberglass insulation with continuous vapor barrier
 - b. Roof drain lines:
 - i. 1/2" minimum thickness fiberglass insulation
 - c. Install cal-sil insert with metal hanger shield at all piping hangers and supports.
 - d. If ball valves are insulated, a 2" handle extension with a protective sleeve shall be provided that allows operation of valve without breaking the vapor seal.
 - e. Piping in areas where damage may occur shall have protective aluminum or other suitable jacket over insulation.
 - f. 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 testing shall meet code.
 2. Project Representative shall be given option of witnessing pressure testing of Plumbing Systems.
- 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.
 1. The procedure shall follow ANSI/AWWA Standard C651, per the current Office of the State Architect (OSA) adopted edition of the International Plumbing Code (IPC).
 2. For buildings already occupied, the procedure shall be modified as required to accommodate the occupants.
 3. The Plumbing Contractor shall notify Facilities Management (FM) through Project Representative when disinfection and testing are complete.
 4. Disinfection report shall be submitted to both Project Representative and FM.
- C. Super–chlorinated water shall be de–chlorinated before discharge.
- D. A disinfection report shall be included in the O&M Manuals.
- E. Floor drains, other drain fixtures and all drain piping exposed during construction shall be covered and protected from debris entering the pipes.
 1. The Drain System shall be flushed in presence of Project Representative at the end of construction and cleaning provided by Contractor if blockage exists.
- F. 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 American Backflow Prevention Association (ABPA) or the Association of Boards of Certification (ABC).

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1. Tests shall be in conformance with the "Colorado Cross-Connection Control Manual" published by the Colorado Department of Public Health & Environment (CDPHE).
- G. Test reports for all backflow prevention devices shall be included in O&M Manuals at the completion of Project.
- H. Hot Water Recirculation System balancing valves shall be included in the TAB Contractor Scope of Work and final report.
- I. 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.
 1. Building service backflow devices shall be located at service point of entry to building.
 - a. Refer to Division 33 – Utilities.
- B. Building Water Supply Systems:
 1. A means of easily flushing the Domestic Water Systems during periods of inactivity shall be provided.
 - a. Refer to discussion under hose-bibbs and wall hydrants in Section 22 11 00.
 2. Buildings with both domestic and industrial water needs, require separated Domestic and Industrial Supply Water Systems in order to centralize and reduce the quantity of backflow devices.
 3. Domestic Systems shall include breakroom sinks, all restroom fixtures, drinking fountains, emergency showers, and eye/face washes.
 4. Industrial Water Systems shall include all other fixtures including lab sinks, fume hoods, interior and exterior hose bibbs/hydrants, and hose reels.
 5. The need for an Industrial Water System may be waived by the Project Representative if the only fixtures it would serve are interior and exterior hose bibbs/hydrants.
 6. In Lab Animal Holding Facilities, animal watering outlets & fixtures shall be sourced from the Domestic Water System.
 - a. Provide backflow separation from the domestic source and a means of flushing.
- C. Once-through equipment cooling with treated water (domestic or industrial) is prohibited.
 1. A Process Cooling System shall be proposed in lieu of domestic water cooling.
 2. However, use of treated water from a separated Industrial Water System as an emergency back-up to a primary Process Cooling System is allowed.
- D. All hot water recirculation piping shall be routed down the wall to counter level.
 1. Unless delivery of hot water to fixtures can be demonstrated to be less than 10 seconds at all times.

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- E. Chemical, carcinogenic, biological or other toxic or hazardous wastes shall not be put into the sanitary sewer.
1. They shall be disposed of by proper methods as approved by Colorado State University (CSU) Environmental Health Services (EHS) and FM through the Project Representative on a case-by-case basis.
- F. General lab waste at sinks and hoods, unless approved otherwise, shall drain to an Acid-Waste and Vent Piping System.
1. Refer to 22 66 00 – Chemical-Waste Systems for Laboratory and Healthcare Facilities.
- G. Stormwater drainage must go into its own Drainage System. This includes surface runoff, rain, snowmelt, and groundwater.
1. Discharge of uncontaminated groundwater and stormwater to the Sanitary Sewer System is prohibited.
 2. Coordinate with the Project Representative to ensure all discharges are conveyed to the appropriate System and any required permits are obtained.
- H. Elevator sump pumps intended to pump the discharge of fire sprinklers must discharge to the sanitary sewer.
1. Oil minder type pumps are prohibited in this situation and the pump shall be fitted with an approved alarm.
 2. Elevator sump pumps in an elevator pit with continuous or periodic groundwater intrusion must discharge to the Storm Sewer System via an oil minder type pump.
 3. Consult FM via the Project Representative for proper application by elevator type.
- I. Building water, sanitary and storm sewer pipes buried under structure shall be laid in on firm, undisturbed or compacted soil with a 6" bed of sand or 1/4" gravel below and above piping.
1. Compaction tests shall be required when excavation removes soil below piping bed.

22 11 00 – FACILITY WATER DISTRIBUTION

- A. Domestic and Industrial Water Piping (above grade):
1. Acceptable Products:
 - a. 2" and smaller:
 - i. Type-L copper with sweat fittings
 - b. Larger than 2":
 - i. Type-L copper with soldered fittings
 2. Products not Allowed:
 - a. Grooved, push-to-connect, or gasketed press-joined Systems of any kind
 - b. PVC, CPVC, PEX, HDPE, or other Plastic Piping Systems
 3. Discussion:
 - a. None listed

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B. Domestic and Industrial Water Piping Specialties – Backflow Preventers:

1. Acceptable Products:
 - a. Reduced pressure principal devices:
 - i. Apollo/Conbraco
 - ii. Wilkins/Zurn
 - iii. Watts/Ames
 - b. Double check devices:
 - i. Apollo/Conbraco
 - ii. Wilkins/Zurn
 - iii. Watts/Ames
2. Products not Allowed:
 - a. Reduced pressure principal devices:
 - i. Febco with epoxy coated interior
 - b. Double check devices:
 - i. Ames
 - ii. Febco with epoxy coated interior
3. Discussion:
 - a. Backflow prevention devices and design shall comply with the current OSA adopted edition of the IPC and the "Colorado Cross-Connection Control Manual" published by the CDPHE.
 - b. Reduced pressure backflow prevention devices shall be installed for all main water services to University buildings, except residential buildings less than 40'-0" 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 CDPHE.
 - d. Water Piping Systems must be arranged and backflow prevention devices installed so that back siphonage or backflow into Domestic Systems is not possible.
 - i. Centralized backflow equipment is preferred over point-of-use devices.
 - ii. Easily accessed locations are required.
 - iii. Ensure that adequate means of drainage exist at each backflow device to facilitate testing such as floor sink fixtures.
 - 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'-0" in height.
 - i. Each device shall be sized to handle half the building's full load.
 - ii. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents.
 - g. Outdoor applications shall be enclosed within a University-approved, insulated enclosure with an integral electric heater.
 - i. 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" above the floor, 36" clearance above the device, 12" out from wall on back side, and 24" clearance in front of test cocks), no higher than 5'-0" above floor unless permanent platform is provided.

C. Domestic and Industrial Water Piping Specialties – Hose Bibbs, Wall, and Roof Hydrants:

1. Acceptable Products:
 - a. Woodford

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- b. Zurn
 - c. Josam
 - d. Or approved equal
2. Products not Allowed:
 - a. Non key–operated wall hydrants
 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.
 - i. These shall be located as inconspicuously as possible consistent with accessibility.
 - ii. 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 and Commuter Showers shall have a key–operated wall hydrant or hose bibb for Building Services cleaning work.
 - e. All Domestic Cold Water Systems shall be provided with an easily accessible means of quickly flushing stagnant water from the entire building.
 - f. Provide freeze–proof roof hydrants near air handling coils requiring periodic cleaning.
- D. Domestic and Industrial Water Piping Specialties (Vacuum Breakers, PRVs, Mixing Valves, Strainers, Shock Absorbers):
1. Acceptable Products:
 - a. None listed
 2. Products not Allowed:
 - a. None listed
 3. Discussion:
 - a. Shock absorbers shall be placed in water lines to equipment that might produce water hammer.
 - b. Isolation valves shall be installed at shock absorbers. This equipment shall be readily accessible.
 - c. Provide a vacuum breaker on any plumbing device which has a hose connection.
- E. Domestic and Industrial Water Circulation Pumps:
1. Acceptable Products:
 - a. Bell & Gossett
 - b. Taco
 - c. Grundfos
 - d. Or approved equal
 2. Products Not Allowed:
 - a. 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.

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- b. "Quiet" operation shall be specified for pumps outside of mechanical rooms where noise is a consideration.
 - i. Lower pump speed can greatly reduce life cycle maintenance cost. High-speed pumps may have lower first cost as well as higher operating efficiency but these shall not be the only selection criteria.

22 12 00 – FACILITY POTABLE-WATER STORAGE TANKS

A. Water Pressure Tanks:

- 1. Acceptable Products:
 - a. None listed
- 2. Products Not Allowed:
 - a. None listed
- 3. Discussion:
 - a. In general, atmospheric storage vessels for domestic cold water are not allowed.
 - i. 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.

22 13 00 – FACILITY SANITARY SEWERAGE

A. Sanitary Waste and Vent Piping:

- 1. Acceptable Products:
 - a. Satisfy current OSA adopted edition of the IPC.
- 2. Products not Allowed:
 - a. Drain, waste and vent interior piping:
 - i. ABS and galvanized piping
- 3. Discussion:
 - a. Hard piped fixture venting is preferred over mechanical air admittance valve devices requiring added maintenance.

B. Sanitary Waste Piping Specialties – Cleanouts:

- 1. Acceptable Products:
 - a. None listed
- 2. Products not Allowed:
 - a. None listed
- 3. Discussion:
 - a. Interior accessible cleanout caps and plugs shall be located such that they can be removed without damaging the floor or floor covering.
 - b. All cleanouts exterior to the building shall be two-way type, to permit cleaning in both directions.
 - i. Plugs shall be lubricated at installation.
 - ii. Refer to standard details.

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C. Sanitary Waste Piping Specialties – Floor Drains:

1. Acceptable Products:
 - a. Drains:
 - i. Josam
 - ii. Zurn
 - b. Trap Sealing Devices:
 - i. ProSet Trap Guard
 - ii. Sure Seal Trap Sealer
 - iii. 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.
 - i. The trap shall be 3” minimum in size to help keep it from drying out or be fitted with a trap sealing device.
 - 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 in hot areas such as mechanical rooms shall be protected by a trap sealing device.

D. Sanitary Waste Interceptors and Separators:

1. Acceptable Products:
 - a. None listed
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Where required, appropriately sized interceptors and separators shall be provided for entire building as well as point of use processes.
 - b. Design of units not governed by local codes and ordinances shall be sized for the anticipated use and cleaning interval with the latter determined through discussion with Project Representative.
 - i. Larger tanks are beneficial to ensure separation as well as increase time between cleaning.
 - c. Separators shall be located to ensure access, servicing, and venting and preferably be located outside.

E. Sanitary Waste Pumps and Pump Stations:

1. Acceptable Products:
 - a. Submersible Sump Pumps:
 - i. Weil
 - ii. Or approved equal
2. Products not Allowed:
 - a. None listed
3. Discussion:

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- 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’–0” of 3–conductor PVC cord and molded grounding plug.
- c. Controls shall include float–operated (non–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 the Building Automation System (BAS).
- d. Sump pump operations shall have high water alarms connected to the BAS.
- e. Sump pump controls for Duplex Systems shall automatically alternate lead–lag operation between pumps
- f. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents 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).
- h. Provide submersible sewage ejectors with quick remove system including floor discharge elbow, stainless steel lifting rope and upper guide pipe bracket.

F. Septic Tanks:

1. Acceptable Products:
 - a. (future)
2. Products not Allowed:
 - a. (future)
3. Discussion:
 - a. (future)

22 14 00 – FACILITY STORM DRAINAGE

A. Storm Drainage Piping:

1. Acceptable Products:
 - a. Satisfy current OSA adopted edition of the IPC
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)

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C. Storm Drains – Roof Drains, Area Drains, and Trench Drains:

1. Acceptable Products:
 - a. Roof drain domes shall be metal.
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:
 - i. Stancor Oil-Minder
 - ii. Or approved equal
 - b. Submersible Sump Pumps for Storm or Groundwater Service:
 - i. Weil
 - ii. Crane
 - iii. AMT
 - iv. 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'-0" of 3-conductor PVC cord and molded grounding plug.
 - c. Controls shall include float-operated (no-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 the BAS.
 - e. Sump pump controls for Duplex Systems shall automatically alternate lead-lag operation between pumps.
 - i. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents for sump pump piping arrangement.
 - f. Provide pumps with quick remove system including floor discharge elbow, stainless steel lifting rope and upper guide pipe bracket.

22 30 00 – PLUMBING EQUIPMENT

- A. Hot water design conditions shall conform to current OSA adopted edition of the IPC.
- B. Higher temperature hot water needed for dishwashers, etc. shall be attained by booster heating units furnished as part of the equipment.
- C. Mixing valves shall not be used on any faucets.
 1. Mixing valves may be allowed where "hands-off" operation of the faucet is required.
 - a. This application shall be approved by FM through the Project Representative.

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- 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.
 - 1. 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.
 - 1. Elevated water heaters shall have drip pans installed with indirect drainpipes to floor drains or other drain fixtures.
- I. In buildings containing Industrial Hot Water Systems, a second water heater may be required.

22 32 00 – DOMESTIC WATER FILTRATION EQUIPMENT

- 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:

- 1. Acceptable Products:
 - a. E-Max
 - b. Or approved equal
- 2. Products not Allowed:
 - a. None listed
- 3. Discussion:
 - a. None listed

B. Instantaneous Tankless Electric Water Heaters:

- 1. Acceptable Products:
 - a. Hubble
 - b. Or approved equal
- 2. Products not Allowed:
 - a. None listed
- 3. Discussion:
 - a. Units shall be commercial grade.
 - b. Residential grade units are not allowed.

C. Tank-Type Electric Water Heaters:

- 1. Acceptable Products:
 - a. Hubble
 - b. Rheem
 - c. AO Smith

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- d. Bradford White
 - e. Or approved equal
2. Products not Allowed:
- a. None listed
3. Discussion:
- a. Units shall be commercial grade.
 - b. Residential grade units are not allowed
 - c. Long-life corrosion resistant duplex stainless tanks preferred over glass lined tanks requiring anode rods.

22 34 00 – FUEL-FIRED DOMESTIC WATER HEATERS

A. Instantaneous Tankless Gas Water Heaters:

1. Acceptable Products:
- a. Hubble
 - b. Noritz
 - c. Or approved equal
2. Products not Allowed:
- a. None listed
3. Discussion:
- a. Units shall be commercial grade.
 - b. Residential grade units are not allowed.
 - c. Condensing units are preferred.

B. Gas-Fired Storage Tank Water Heaters:

1. Acceptable Products:
- a. Hubble
 - b. Rheem
 - c. AO Smith
 - d. Bradford White
 - e. Or approved equal
2. Products not Allowed:
- a. None listed
3. Discussion:
- a. Units shall be commercial grade.
 - b. Residential grade units are not allowed.
 - c. Long-life corrosion resistant duplex stainless tanks preferred over glass lined tanks requiring anode rods.

22 35 00 – DOMESTIC WATER HEAT EXCHANGERS

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

1. Acceptable Products:
- a. Flo-Rite-Temp from Armstrong

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2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Water heaters shall be instantaneous type, steel and brass shell & tube heat exchanger with integral hot water differential pressure diaphragm mixing control valve accurate to +/- 4 deg-F, integral feed forward controller, CIP (clean-in-place) connection ports, isolation valves, suitable for operation at 15 psig steam pressure.
 - b. Unit can be fitted with digital hot water mixing control valve if tighter tolerance of hot water temperature is required.
 - c. Storage Tank Systems with steam coil are prohibited.
 - d. Exchangers can be single wall if the building is connected to the Main Campus steam utility.
 - i. 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
 - b. 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 42 00 – COMMERCIAL PLUMBING FIXTURES

A. Water Closets and Urinals:

1. Acceptable Products:
 - a. American Standard
 - b. Kohler
 - c. 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. Floor mounted water closets are allowed in approved locations but must be gravity flush.

B. Lavatories and Sinks:

1. Acceptable Products:
 - a. Lavatories:
 - i. Bradley Verge LVL-Series
 - ii. Or approved equal
 - b. Laboratory Sinks/Tubs:
 - i. Dura Top

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- ii. Just Manufacturing
- iii. Zurn
- iv. American Standard
- v. Chicago
- vi. Kohler
- vii. 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'.
- c. Fixtures shall be complete as described in the Manufacturer's catalog.
- d. All lab sinks and tubs shall be listed as chemical resistant. Acceptable materials are stainless steel and epoxy.
- e. 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.
- d. 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
- b. 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:
 - i. American Standard
 - ii. Kohler
 - iii. Zurn
 - iv. Chicago

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- v. Or approved equal
 - b. Laboratory Faucets:
 - i. American Standard
 - ii. Kohler
 - iii. Zurn
 - iv. Chicago
 - v. T&S
 - vi. Or approved equal
 - c. Trim:
 - i. American Standard
 - ii. Kohler
 - iii. Zurn
 - iv. Chicago
 - v. Or approved equal
- 2. Products not Allowed:
 - a. None listed
- 3. Discussion:
 - a. Include integral backflow prevention devices on all laboratory faucets.
 - b. All faucets shall be manually operated.
 - i. Non–automatic devices (e.g. IR) are preferred.
 - c. Lavatory faucets shall be fitted with aerators limiting flow to 0.5 gpm and shall be pressure independent.
 - d. Faucets in breakrooms and labs shall be fitted with aerators limiting flow to 2.2 gpm and shall be pressure independent.
 - e. All lavatory faucets shall have 4 or 8” center spread.
 - i. 8” center spreads are allowed for laboratory, food service or custodial sinks.
 - f. All faucets shall have 1/4 turn service stop valves that are easily accessible. Provide access panels where needed.

F. Flushometers:

- 1. Acceptable Products (Flushometer Valves):
 - a. Sloan (preferred)
 - b. American Standard
- 2. Products not Allowed:
 - a. Toto
 - b. Zurn
- 3. Discussion:
 - a. Manual operated flushometer valves are preferred.
 - i. Automatic devices may be allowed if approved by Project Representative discussing whether devices are to be battery powered or hard–wired.
 - b. Water closet flushometers shall be no more than 1.28 gallons per flush.
 - c. Urinal flushometers shall be no more than 1/8 gallon per flush.
 - d. All flushometers shall have 1/4 turn service stop valves that are easily accessible.
 - e. Provide access panels where needed.

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22 45 00 – EMERGENCY PLUMBING FIXTURES

A. Emergency Showers:

1. Acceptable Products:
 - a. Bradley
 - b. Haws
 - c. Or approved equal
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Shall meet ANSI standards
 - b. The need for a floor drain at an emergency shower shall be discussed with the Project Representative and Environmental Health Services (EHS) on a per Project basis during Project development.

B. Eyewash Stations:

1. Acceptable Products:
 - a. Bradley
 - b. Haws
 - c. Eyepod
 - d. Or approved equal
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Shall meet ANSI standards
 - b. Quantities and locations of eyewashes shall be discussed with the Project Representative and EHS on a per Project basis during Project development.

C. Emergency Fixture Water–Tempering Equipment:

1. Acceptable Products:
 - a. Bradley
 - b. Leonard
 - c. Simmons
 - d. Or approved equal
2. Products Not Allowed:
 - a. None listed
3. Discussion:
 - a. Shall be readily accessible

22 47 00 – DRINKING FOUNTAINS AND WATER COOLERS

A. Drinking Fountains:

1. Acceptable Products:
 - a. Water Coolers:

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- i. Elkay Model VRC8S or approved vandal-resistant equal
 - b. Bottle Filling Stations:
 - ii. Elkay or approved vandal-resistant equal
 - iii. Bottle Filling Stations shall be sensor operated only.
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Mechanically cooled drinking fountains shall be self-contained wall mounted type drinking water coolers.
 - b. 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.
 - c. Water coolers shall be equipped with handicapped fittings and be specified and located according to ADA requirements including a bi-level design if space allows.
 - d. Care shall be taken to specify coolers with basins and spouts to minimize dripping, etc. on floor.
 - e. Water coolers shall have an isolation valve located in an accessible location.
 - f. The design of multiple water coolers shall include an evaluation into the use of a single Refrigeration Cooling System with multiple water cooler outlets.
 - g. Water coolers and/or water bottle filling stations shall not include a filter or filter status indicator light, either integral or after-market.
 - i. Filters are prohibited.
 - h. Construction: Designed for indoor or outdoor use, stainless steel cabinet and drain pan (no plastic piece under filler area).
 - i. Single drain (no second drain under bottle filler area), one-piece vandal resistant bubbler.
 - i. For units with water bottle filling, a counter tracking number of fills is preferred but not required.
 - j. Fifty percent (50%) of required drinking fountains shall be equipped with water bottle filling stations with minimum of one (1) water bottle filling stations shall be provided per floor in new construction.

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 shall be sized on the basis of number of outlets, using a figure of 0.5 cfm at 30 psig per outlet.
 - i. Diversity must be determined by the designer.
 - ii. System loss shall not exceed 5 psig loss at estimated peak demand.
 - c. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents for process compressed air supply piping arrangements.

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B. Compressed Air Equipment:

1. Acceptable Products:
 - a. (future)
2. Products not Allowed:
 - a. (future)
3. Discussion:
 - a. A building duplex compressor shall 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.
 - c. 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 shall be sized on the basis of inlets.
 - i. Use a figure of 1 cfm per outlet and 40 percent simultaneous use for typical laboratory rooms.
 - c. Friction loss shall not exceed 5" of mercury column drop at estimated peak demand.
 - i. The above shall be modified to meet special conditions and types of rooms or service.

B. Vacuum Equipment:

1. Acceptable Products:
 - a. Vacuum Pumps:
 - i. Nash
 - ii. Or approved 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.
 - b. Pumps equal to or larger than 15 hp shall operate at 1200 rpm.
 - c. Flat plate porting is not permitted because it uses more domestic water.

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22 63 00 – GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Natural Gas Piping:

1. Refer to Section 23 11 00 – Facility Fuel Piping.

22 66 00 – CHEMICAL–WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Lab Acid–Waste and Vent Piping:

1. Acceptable Products:
 - a. Enfield Industrial Corp.
 - b. Orion
 - c. Zurn
2. Products not Allowed:
 - a. Pyrex or other glass pipe
3. Discussion:
 - a. Pipes shall be acid resistant, flame–retardant polypropylene pipe.
 - b. Below grade pipes shall be Schedule 80 with heat fusion joints.
 - c. 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. Tanks containing limestone chips
3. Discussion:
 - a. Treatment and handling of acid wastes shall be discussed with FM Engineering through the Project 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.
 - i. Vault lids shall be placed such that all equipment is accessible and removable.
 - c. Limited point of use neutralization is allowed upon approval of FM Engineering.

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

A. Purified Water Piping:

1. Acceptable Products:
 - a. Distilled Water:
 - i. PVC, Grade 1, Type 1, Schedule 80, unplasticized material equal to MFG Celenesse Type 1 (formerly Cabot).
 - b. Reverse–Osmosis (RO) Water:
 - i. Unpigmented, natural polypropylene conforming to ASTM D4101 with thermal welded fittings and mechanical joints.
 - c. Deionized (DI) Water:
 - i. Unpigmented, natural polypropylene conforming to ASTM D4101 with thermal welded fittings and mechanical joints.

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2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. For higher delivered distilled water quality requirements, other piping materials may be necessary.
 - b. 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.
 - c. For applications that require higher quality DI water, other materials may be needed.
 - i. The Project Representative must approve any material substitutions with the recommendation of the DI Water Vendor.
 - d. 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.
 - e. Any metal components in DI water piping shall be 316 Stainless.
 - f. Piping Systems shall be configured to minimize dead legs.

B. Purified Water Equipment:

1. Acceptable Products:
 - a. Distilled Water:
 - i. None listed
 - b. RO Water:
 - i. Coordinate with current CSU Contract Vendor.
 - ii. Contact Utility Services through the Project Representative.
 - c. DI Water:
 - i. Coordinate with current CSU Contract Vendor.
 - ii. Contact Utility Services through the Project Representative.
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Distilled Water Systems may be connected to existing stills.
 - i. Verify existing capacity information with FM Plumbing Shop through the Project Representative.
 - 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 industrial cold water and steam or electric power.
 - d. Installation of DI and RO Water Systems is to be included in the Scope of the Project.
 - i. Service to these Systems, after acceptance, is performed by an outside Vendor for the University under existing purchase order Agreements.
 - ii. Installation shall be performed by this same Service Vendor.
 - iii. Vendor contact information is available from the Project Representative.
 - e. The quantity and quality of the deionized water shall be established by the user in cooperation with the Vendor through the Project Representative.
 - i. Design requirements shall be coordinated through these parties through the Project Representative.
 - ii. All DI Water Systems shall conform to Clinical and Laboratory Standards Institute (CLSI, formerly NCCLS) guideline C3–A4. A copy of this guideline is available from FM Utility Services.

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- 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.
 - i. Additional components, such as ultrafiltration or reverse osmosis units may also be required.
 - ii. 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.
 - iii. Branches shall be fitted with appropriate flow control and metering devices.
- g. Utilities shall be provided by the Project to the DI System and shall include industrial cold water and an electrical power outlet.
 - i. For Centralized Systems, power for circulating pumps, sterilizers and controls shall be required.
- h. Purified Water Systems shall include leak detection capable of shutting off water flow and that doesn't require power for under-sink laboratory systems.

END OF DIVISION