DIVISION 22 - PLUMBING

See Part II for additional information regarding Energy Efficiency, etc.

DESIGN CRITERIA

Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements.

Telecommunications rooms shall be dedicated to the telecommunications function and related support facilities and shall not be shared with plumbing piping other than that serving the room itself. Piping shall not be installed in, pass through, or enter the telecommunications room.

COMMON MOTOR REQUIREMENTS

See Section 23 05 13 in Division 23.

METERS & GAGES FOR PLUMBING PIPING

Provide for each new building, or portions of new buildings with separate meters for water and gas. Portions of existing buildings and large additions, or remodels of existing buildings may also require separate meters. Verify all requirements with the University's Representative.

<table>
<thead>
<tr>
<th>Utility or Service</th>
<th>Manuf.</th>
<th>Model #</th>
<th>Accessories/Order Options</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diaphragm Meter</td>
<td>American Meter Company Or to match Existing</td>
<td>Diaphragm Gas Meter, Model AC-250, AL-425 or AC 630</td>
<td>Miners &amp; Pisani CMC-1 or CMC-2 Domestic Meter Pulsing Index (AC 250 Meter uses CMC-1)</td>
<td>Design Engineer to provide building natural gas max flow for sizing. Meter installation must include a Seismic Shut-off Valve. Install a ¾&quot; conduit from the remote totalizer to a utility J-box in the Mechanical room. Connect to power monitor for SCADA interface per connection diagram.</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diaphragm Meter</td>
<td>American Meter Company Or to match Existing</td>
<td>Diaphragm Gas Meter, Model AC-630, AL-800, AL 1000</td>
<td>Miners &amp; Pisani MVP-10 Magnetic Volume Pulser</td>
<td>See above</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotary Meter</td>
<td>American Meter Company Dresser Roots Meter Or to match Existing</td>
<td>RPM Series 9.0C - 11M, 1 ½” - 4” Flanged</td>
<td>Low Frequency Pulser KleanLine Flanged Filter (or equal)</td>
<td>See above</td>
</tr>
</tbody>
</table>

See above
### Natural Gas Regulator

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Meter Company</td>
<td>Or to match Existing</td>
</tr>
<tr>
<td><strong>3/4” 1813C</strong></td>
<td><strong>FPT</strong> Range 6”-15” W.C. (water column)</td>
</tr>
<tr>
<td><strong>1” 1813C</strong></td>
<td><strong>1” FPT</strong> Range 6”-15” W.C. (water column)</td>
</tr>
<tr>
<td><strong>1 1/2” 1833B</strong></td>
<td><strong>1 1/2” FPT</strong> Range 8.5” - 14” W.C. (water column)</td>
</tr>
<tr>
<td><strong>2” 1833B</strong></td>
<td><strong>2” FPT</strong> Range 8.5” - 14” W.C. (water column)</td>
</tr>
</tbody>
</table>

- Design Engineer to provide building natural gas max flow for sizing.

### Seismic Shut-off Valve

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Seismic Products - Koso</td>
<td>Or Equal</td>
</tr>
<tr>
<td><strong>300 Series</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Domestic Water Meter Size

#### ¾” - 2”

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensus SR1 Series</td>
<td>(to match existing)</td>
</tr>
<tr>
<td>Positive Displacement Meter with an Impulse Contactor Transmitting Register 10 gallons/contact</td>
<td></td>
</tr>
</tbody>
</table>

- * Repeater Totalizer. ACT-PAK Model 7112-1 with non-resettable totalizer. Totalizer to read in 10 gallon increments.

- Design Engineer to size meter based on building maximum flow.

- 1 ½” & 2” meters shall be flanged.

- Connect the impulse contactor to the remote totalizer (if provided) or the power monitor. Install a ¾” conduit from the impulse contactor or remote totalizer (if provided) to a J-box within 5 feet of the electric panel housing the electric power monitor. Connect to power monitor for SCADA interface per connection diagram.

### Domestic Water Meter Size

#### 3” - 8”

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensus SRH Series</td>
<td>(to match existing)</td>
</tr>
<tr>
<td>Compound Meter with an Impulse Contactor Transmitting Register 10 gallons/contact</td>
<td></td>
</tr>
</tbody>
</table>

- * Repeater Totalizer. ACT-PAK Model 7112-1 with non-resettable totalizer. Totalizer to read in 10 gallon increments.

- Design Engineer to size meter based on building maximum flow.

- Provide & install a Sensus AWWA type Bronze strainer and valved meter bypass assembly.

- Connect the impulse contactor to the remote totalizer (if provided) or the power monitor. Install a ¾” conduit from the impulse contactor or remote totalizer (if provided) to a J-box within 5 feet of the electric panel housing the electric power monitor. Connect to power monitor for SCADA interface per connection diagram.

### Domestic Water Meter Size

#### > 2”

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensus (to match existing)</td>
<td></td>
</tr>
<tr>
<td><strong>Compound Meter with an Impulse Contactor Transmitting Register 10 gallons/contact</strong></td>
<td></td>
</tr>
</tbody>
</table>

- Repeater Totalizer – ACT-PAK Model 7112-1 with non-resettable totalizer. Totalizer to read in 10 gallon increments.

- Design Engineer to provide building max flow for sizing.

- 1 ½” & larger meters shall be flanged.

- Greater than 2” meters require an AWWA strainer and valved by-pass assembly.

- Complete the reduction to the remote totalizer to the
1. Repeater Totalizer is required only when meter cannot be easily read directly, as determined by the University's representative.

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The following meters are typically not required but may be requested on specific projects.

<p>| Utility Water Meter (IF REQUIRED) Size ¾&quot; - 2&quot; | Sensus SR1 Series (to match existing) | Positive Displacement Meter with an Impulse Contactor Transmitting Register 10 gallons/contact <a href="http://www.sensus.com">http://www.sensus.com</a> | * Repeater Totalizer. ACT-PAK Model 7112-1 with non-resettable totalizer. Totalizer to read in 10 gallon increments. | Design Engineer to size meter based on building maximum flow. 1 ½ &quot; &amp; 2&quot; meters shall be flanged. Connect the impulse contactor to the remote totalizer (if provided) or the power monitor. Install a ¾ &quot; conduit from the impulse contactor or remote totalizer (if provided) to a J-box within 5 feet of the electric panel housing the electric power monitor. Connect to power monitor for SCADA interface per connection diagram. |
| Utility Water Meter (IF REQUIRED) Size 3&quot; – 8&quot; | Sensus SRH Series (to match existing) | Compound Meter with an Impulse Contactor Transmitting Register 10 gallons/contact <a href="http://www.sensus.com">http://www.sensus.com</a> | * Repeater Totalizer. ACT-PAK Model 7112-1 with non-resettable totalizer. Totalizer to read in 10 gallon increments. | Design Engineer to size meter based on building maximum flow. Provide &amp; install a Sensus AWWA type Bronze strainer and valved meter by-pass assembly. Connect the impulse contactor to the remote totalizer (if provided) or the power monitor. Install a ¾ &quot; conduit from the impulse contactor or remote totalizer (if provided) to a J-box within 5 feet of the electric panel housing the electric power monitor. Connect to power monitor for SCADA interface per connection diagram. |</p>
<table>
<thead>
<tr>
<th>Utility Water (IF REQ'D)</th>
<th>Sensus (to match existing)</th>
<th>Compound Meter with an Impulse Contactor Transmitting Register 10 gallons/contact <a href="http://www.sensus.com">http://www.sensus.com</a></th>
<th>Repeater Totalizer – ACT-PAK Model 7112-1 with non-resettable totalizer. Totalizer to read in 10-gallon increments.</th>
<th>Design Engineer to provide building max flow for sizing. Greater than 2&quot; meters require an AWWA strainer and valved by-pass assembly. Connect the remote totalizer to the impulse contactor. Install a ¾&quot; conduit from the remote totalizer to a utility J-box in the Mechanical room. Connect to power monitor for SCADA interface per connection diagram.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter Size 2&quot; and smaller</td>
<td>Sensus (to match existing)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DI Water (IF REQ'D)</td>
<td>Badger AMCO Or Equal</td>
<td>Thermoplastic Disc meter, Model 25 or Model 40 C700 Positive Displacement Meter</td>
<td>Meter shall be located in the same space as DI equipment. If the facility is connected to campus DI system, a lockable valved bypass assembly shall be installed. For facilities that have RO units installed as part of the DI water treatment system, the meter shall be installed downstream of the RO unit.</td>
<td></td>
</tr>
<tr>
<td>Waste Water (Sewer) &amp; Storm Drainage Lift Station Discharge</td>
<td>Rosemount, ABB, Sparling TigerMag Or Equal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Repeater Totalizer is required only when meter cannot be easily read directly, as determined by the University’s representative.

**HANGERS AND SUPPORTS FOR PLUMBING PIPING & EQUIPMENT**

**LIFTING EYE AT SUMPS AND PITS**
Provide a lifting eye or insert in structure over any pump pit or sump located in a building to aid in future removal of equipment.

**ISOLATORS**
Provide pipe isolator at all hangers for non-insulated lines.

**FACILITY DRAINAGE PIPING CLEANOUTS**

Size cleanouts to match pipe size up to a maximum cleanout size of 4 inches. Make all cleanouts accessible. If cleanouts are installed in an accessible ceiling space, the cleanout must be extended through the floor above. Use graphite on all cleanouts with all threads being thoroughly greased after acceptable pressure test.
LOCATIONS
1. Horizontal offsets.
2. Ends of all waste, water or storm drain lines more than 5 feet in length.
3. 100 foot maximum intervals in all horizontal runs within the building lines.
4. Base of all stacks and storm drain lines.
5. Lateral branch of common restroom fixtures, and at pipe size changes in lateral branch and main sanitary sewer pipe runs.

TYPES
1. Exposed: Cast iron plug.
2. In Wall: Cast-iron body, stainless steel cover.
3. In Floor or Grade: Adjustable, cast-iron body, ABS thread plug.

PLUMBING INSULATION 22 07 00
Insulate:
- Overflow and roof drain piping inside the building.
- Water piping exposed to the weather
- Domestic hot water and industrial hot water piping.

COMMISSIONING OF PLUMBING 22 08 00

DISINFECTION OF WATER SYSTEMS
DISINFECT ALL DOMESTIC HOT AND COLD WATER SYSTEMS IN ACCORDANCE WITH SECTION 33 13 00 DISINFECTION OF WATER UTILITY DISTRIBUTION SYSTEMS. TESTS AND ADJUSTMENTS
Isolate from the system all existing piping systems and new or existing equipment which may be damaged by test pressure. Test only new piping. Final connection between new and existing piping shall be tested at normal system operating pressures. Make no test against a service valve or meter. No loss in pressure or visible leaks shall show after 4 hours at the pressures indicated:

<table>
<thead>
<tr>
<th>System Tested</th>
<th>Test Pressure</th>
<th>Test With Sanitary and Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary and Lab, Waste, Drain, Vent</td>
<td>10 ft. hd.</td>
<td>Water</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>150 PSI</td>
<td>Air &amp; Soap</td>
</tr>
<tr>
<td>Deionized Water</td>
<td>100 PSI</td>
<td>Deionized Water</td>
</tr>
<tr>
<td>Industrial and Domestic Hot &amp; Cold Water</td>
<td>150 PSI*</td>
<td>Water</td>
</tr>
<tr>
<td>Gas</td>
<td>100 PSI</td>
<td>Air &amp; Soap</td>
</tr>
<tr>
<td>Vacuum</td>
<td>150 PSI, 27 inch vac.</td>
<td>Air &amp; Soap</td>
</tr>
</tbody>
</table>
|                                             |               | *(or 1.5x operational pressure, whichever is higher)

Waste and Vent Piping Testing: Apply to the system either in its entirety or in sections. Where a portion of the piping system is to be concealed before completion, this portion shall be tested separately as specified for the entire system.
Water, Gas, Compressed Air, and Vacuum Piping Testing: Provide a pressure gauge located at the highest point of the system being tested, with a shutoff valve and bleeder valve so arranged to check gauge operation.

### FACILITY WATER DISTRIBUTION 22 11 00

#### PIPING
Underground: Type K copper tubing, hard temper, cold drawn. For piping 3 inches and larger; polyvinyl chloride pressure pipe C900 bell and spigot with elastomeric ring.
Above Ground: Type L copper tubing, hard temper, cold drawn.

#### JOINTS
Copper Tubing: 1-1/4 inch and larger for above grade piping and all below grade piping, regardless of size, shall be brazed with silver solder 1000 degrees F.
Ductile Iron Fittings: Mechanical joint with bolts, gaskets and glands.

#### FITTINGS
Copper tubing: Wrought copper or cast brass solder sweat type.
Polyvinyl Chloride Pipe: Ductile iron mechanical joint fittings (cold water piping only).

#### UNIONS AND FLANGES
Unions and flanges shall be inlet and outlet of all apparatus and equipment, at all valves, and elsewhere as required to facilitate removal of valves and equipment. Flexible lines shall not be used.
Copper Tubing: Ground joint, cast bronze unions for sizes 2 inch and smaller. 150-pound flange, cast brass, for sizes larger than 2 inches.

#### WATER HAMMER ARRESTORS
Air chambers 18 inches long and 1 pipe size larger than rough-in shall be installed at branches to plumbing fixtures. At solenoid valves and make-up valves, provide diaphragm type shock absorber, sized and located in accordance with Plumbing and Drainage Institute Manual WH-201. Provide access panels for arresters.

#### VALVES
Specify threaded or flanged, two piece, bronze body, full port, ball valves, with stainless steel ball and stem, for isolation/shut off valves. Valves shall be located in open, readily accessible areas, and laboratory utilities valves located in open, hallway outside each laboratory. Valves that are concealed are to be accessible via clearly marked access panels no less than 24 by 24 inches square when valves and piping are concealed above or behind new or existing finished surfaces.

Pressure Reducing Valve: All bronze, Teflon disc and diaphragm for hot water service.
Bench Valves: Ball type with tapered sockets with ball and seat compatible with piping material.
HOSE BIBBS
Exterior Hose Bibbs: Provide at 100 feet maximum spacing along exterior walls. Vacuum breaker, loose key handle, 3/4-inch hose outlet, CP rough bronze, vandal proof. Exterior hose bibbs shall be served by industrial or utility water services (not domestic).

Interior Hose Bibbs: Vacuum breaker, loose key handle, 3/4-inch hose outlet, chrome plated brass, vandal proof.

BACKFLOW PREVENTORS
Reduced pressure type, with drain pan and piped to nearest floor drain. Refer to list of approved backflow prevention assemblies published by the State Dept. of Health Services. Provide reduced pressure backflow preventors (RPBP) in tandem and manifolded to minimize interruption to building occupants for testing and repair.

FACILITY SANITARY SEWERAGE 22 13 00
PIPING
No reducing couplings allowed.
Underground: Service weight cast iron no-hub or hub & spigot joined with compression gaskets.
Above ground:
1. >2 inch service weight cast iron no-hub with stainless steel and neoprene coupling.
2. <2 inch service weight cast iron no-hub with stainless steel and neoprene couplings, or schedule 40 galvanized steel pipe joined with Durham type threaded drainage fittings.

FACILITY STORM DRAINAGE 22 14 00
Overflow drain and roof drains should be piped independently to outside. Overflow drain piping shall be daylighted through exterior wall, minimum 18" above grade.

PIPING:
No reducing couplings allowed.
Underground: Service weight cast iron no-hub or hub & spigot joined with compression gaskets.
Above ground: Schedule 80 PVC.

DRAINS
1. Area Drain: Cast iron top.
2. Roof Drain: Cast iron with flange, flashing ring, gravel stop, underdeck clamp, extension, sump receiver, dome strainer, vandal proof.
3. Overflow Drain: same as roof drain plus standpipe.
4. Floor Drain: Cast iron body, N.B. top, with sediment bucket.
COMMERCIAL PLUMBING FIXTURES

Water Connections: Must have rigid metal to metal connections. Slip joints utilizing non-metallic washers are not permitted. All fixtures shall have stops or valves. Risers may not be corrugated tubing.

Install water efficient shower heads and low-flow toilets that exceed building code conservation requirements in all new campus buildings, and where feasible, retrofit existing buildings with these water efficient devices.

FIXTURES

Water Closet: Wall hung, vitreous china, siphon jet action, Maximum Performance (MaP) tested by IAPMO to exceed 500g capacity. With white, open front seat, less cover. Cast iron floor mounted carrier. Dual level water-conserving flush valve (1.1 and 1.6 gal/flush).

Urinal, Handicap: Wall hung, vitreous china. Cast iron floor mounted carrier.


Sink (Counter Mounted): 18 gauge, type 304 stainless steel sink counter mounted, single bowl, 19 inch by 18 inch by 10 inches deep stainless steel. Deck mounted faucet, lever handle, gooseneck, rigid spout plain outlet, Water Saver L631, modified Chicago or equal. 17 gauge chrome plated 1-1/2 inch by 1-1/2 inch trap. Drain: 1-1/2 inch tailpiece, grid strainer.


Industrial Cold Water Outlet: Straight water valve, Water Saver L-28000, Chicago 937, or equal.

Use solar or low-emission water heaters in new or renovated buildings.
EMERGENCY PLUMBING FIXTURES 22 45 00

GENERAL
Emergency eye or eye/facewash equipment shall be provided in all work areas where, during routine operations or foreseeable emergencies, the eyes of an employee may come in contact with a substance which can cause corrosion, severe irritation or permanent tissue damage or which is toxic by absorption. This equipment must meet the performance and installation requirements of American National Standards Institute (ANSI) Z358.1 1998. UCDEH&S will make final determination on selection of equipment to ensure the equipment meets this standard.

LOCATION OF EQUIPMENT
All campus laboratories that use substances described above must have at least one emergency eye or eye/facewash located within the laboratory and as close as possible to the hazard.

A combination eyewash/emergency shower shall be located within a research laboratory using hazardous chemicals as described above; or a combination eyewash/emergency shower may be located outside the laboratory provided an approved eyewash is located in the laboratory. The combination unit must be located so that travel distance is no more than 10 seconds or 100 feet with no obstructions and only one door to pass through to reach the unit.

Hand held drench hoses are not considered eyewash units. They may be used in addition to equipment, which is described as meeting the ANSI standard above. In some cases, a sink-mounted eyewash and a drench hose may be installed in lieu of a combination eyewash/safety shower. Consult UCD EH&S for review and approval of this configuration.

EMERGENCY EYE WASH AND SHOWERS
The approved units must be:
1. Supplied by domestic water.
2. Readily visible and accessible to the laboratory or work site. The unit should be located as close to the hazard as possible and cannot be blocked by building structures, cabinets, supplies or equipment.
3. Provided with an activation device, such as stay open ball valve, that allows the user full movement of both hands after the valve is turned on.
4. Identified with a highly visible sign.
5. Drain will be plumbed to sanitary sewer.
6. Located so as not to pose an electrical shock hazard. No electrical outlets within 6 feet unless GFI protected.
7. Indoor units are not required to deliver tempered water. Units installed outdoors or in adverse climates may need to be tempered. The need for tempered water shall be reviewed and approved by University of California Davis Environmental Health & Safety (UCDEH&S) during the design phase.
EMERGENCY EYE WASH
Approved emergency eye or eye/face wash units are Haws 7611 or Guardian G1805 (laboratory unit - install at sink), Haws 7000BT or Guardian G1750PT (Barrier Free), Haws 7656WC or Guardian GBF 1735DP (recessed), or equal. In addition to the requirements above, the approved units must be:

1. Regulated to provide a spray force of three to six gallons per minute at 30 psi.
2. Mounted such that the water nozzles are 33 inches to 45 inches from the floor level; height should comply with Americans with Disabilities Act of 1990 (ADA) requirements.
3. Mounted so that spray nozzles, when activated, are no more than 18 inches from the counter front when located above work counters or benches.
4. Drain will be plumbed to sanitary sewer.

EMERGENCY SHOWERS
The unit must be installed and located so both the shower and eyewash can be used at the same time by one person. Approved eyewash/emergency shower units are Haws 8346 or Guardian G1909 HFC (GBF1909 Barrier Free), Haws 8355WC (recessed), Guardian GBF2150 (recessed), or equal. Eyewash component must meet the requirements for Emergency Eye Wash above. In addition to the requirements above, the approved units must be:

1. Adequately supplied with potable water to meet the requirements of each component. The shower must be able to deliver a minimum of 30 gallons per minute. The diameter of the water pattern of the shower measured 60 inches above the surface on which the user stands must be a minimum of 20 inches. The center of the spray pattern shall be located at least 16 inches from any obstruction.
2. Supplied by a minimum pipe size of 1 inch.
3. Installed so that the shower head is not less than 82 inches nor more than 96 inches from the surface on which the user stands.
4. Shower component activated yearly to verify proper operation.

COMPRESSED AIR SYSTEMS FOR LABORATORY FACILITIES 22 61 00

GENERAL
Main/standby equipment is not allowed except for buildings that are considered critical by UC Davis. Lead/lag systems are desired for systems requiring 10 HP compressors/pumps and larger (i.e., split 1- 10 HP compressor/pump into 2- 5 HP lead/lag compressor/pumps).

Provide inter-cooled and after cooled, 2 stage compressors/ pumps for all systems 5 HP and larger. Do not provide once through cooling water systems.

PIPING
Above Ground:  Type L copper tubing, hard drawn.
Below Ground:  Type K copper tubing, hard temper, cold drawn with brazed joints.
JOINTS
Silver brazing alloy, melting point above 1000 degrees F, 15 percent silver, 80 percent copper 5 percent phosphorous.

FITTINGS
Wrought copper or brass, solder sweat type. Couplings shall be of the staked stop type.

VALVES
Ball valves
Lab Air Outlets: Line outlet, Ball valve, Chicago 909AGV, T&S or equal.

Points of connection to existing copper air piping in existing buildings shall be crimped or compression type fitting. Soldering is not permitted.

VACUUM SYSTEMS FOR LABORATORY FACILITIES

GENERAL
See Compressed Air System requirements above.

PIPING, JOINTS AND FITTINGS
See Compressed Air System requirements above.

VALVES
Ball valves
Vacuum Outlets: Line outlet, T&S BL-4500-1 Water Saver or equal.

VACUUM PUMP
Furnish air-cooled duplex vacuum unit, Ingersoll-Rand, Worthington, or equal. Unit to come complete with base mounted pumps, American Society of Mechanical Engineers Association (ASME) tank with sight glass, drain, flexible connection, scrubber, check valves, relief valves, control panel including fused disconnect, vacuum switches and gauges, motors, starters, electrical alternator. NEMA rating shall be specified based on the location of equipment.

GAS SYSTEMS FOR LABORATORY FACILITIES

PIPING, JOINTS AND FITTINGS
See Compressed Air System requirements above. Suitable adapters shall be used for installation of valves and other equipment provided with threaded connections. Copper tubing shall be specially packaged, factory evacuated and sealed, and as recommended for the service by the manufacturer. Dry borax or borax mixed with water may be employed. Borax and alcohol mixtures shall not be used.
VALVES
Section Zone Valves: Union ball valves.
Pressure Gauges: Pressure or vacuum type as required.
Gas Outlets: See Vacuum System requirements above.
Fuel Gas: Lubricated plug cock
Laboratory Nitrogen and Argon; plug valve, Buna-N O-ring, Circle Seal 9259, or equal, (no known equal).

INSTALLATION
Screwed Connections: Wherever possible, screwed joints made in attaching valves, or other permanently connected equipment shall be silver brazed after assembly using precautions to avoid overheating the value or equipment. Where conditions do not permit this method of assembly, the connection joints shall be tinned or sweated with solder. No joint compound shall be used.

Bends: All changes in direction requiring turns or offsets of radius less than 5 times the outside tube diameter shall be made by solder type fittings. All bends must be free from any appreciable flattening, buckling or thinning of the tube wall at any point.

Tees, Reducers and Plugs: All branch connections reducing joints or closing of the ends shall be made by solder type fittings.

Washing Oxygen Piping: Before erection, all tubing, valves and fittings on which the factory seal is broken, shall be thoroughly cleansed of oil, grease, and other combustible materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixed in the proportions of one pound to three gallons of water. Scrubbing shall be employed where necessary to insure complete cleaning. After washing, the materials shall be rinsed thoroughly with clean water. After cleaning, particular care must be exercised in the storage and handling of all tube and fittings and in the condition of tools used in cutting or reaming to prevent oil or grease being introduced into the tubing. Where such contamination has occurred the items affected must be rewashed.

ERECTION
Grounding: All oxygen, nitrous oxide and vacuum lines shall be grounded to the water supply system to reduce the possibility of static electric charges.

Labeling of valves: Each section shut-off valve shall be properly identified with a sign attached to, or placed in the immediate vicinity of the valve. Such identification shall be substantially as follows: “DO NOT CLOSE EXCEPT IN AN EMERGENCY -- THIS VALVE CONTROLS SUPPLY OF OXYGEN TO THE FOLLOWING ROOMS”. Label shall also identify area or rooms served by valve.

Color Coding: All oxygen piping shall be continuously labeled at a spacing of 2’ to the outlets; this also includes concealed piping. All painting shall consist of first quality products.
LABORATORY CHEMICAL WASTE AND VENT PIPING

PIPING
Underground: Schedule 40 flame retardant polypropylene pipe and fittings joined with fusion coil joints, Enfield “Enfusion” or equal.

Above ground concealed: Schedule 40 flame retardant polypropylene pipe and fittings joined with fusion coil joints, Enfield “Enfusion” or equal.

Above ground accessible: Schedule 40 flame retardant polypropylene pipe and fittings joined with grooved pipe mechanical joint fittings by Enfield “Labline” or equal. Compression fitting is not acceptable. All acid waste piping around benches and equipment shall have mechanical joint fittings. Chemically resistant glass drain line piping may be used for repair of material in existing buildings only.

TRAPS
Universal, 1-1/2 inch Polypropylene clear base, Enfield W5115, Harrington or equal. Acid waste traps for equipment shall be Nalgene 96025-1500, Sloane, or equal, drum trap with drain connection adapter and union connection. Sanitary waste traps for equipment shall be “P” type, 17 gauge, cast brass, slip joint nuts, cast brass escutcheons, and cleanout plug.

SUPPORTS
Horizontal polypropylene piping shall have a continuous 16-gauge galvanized sheet metal trough support or maximum 2 foot support spacing system.

FIXTURES
Funnel Sink: Cast iron, with trap and 6 inch diameter inlet.
Cup Sink: Polyethylene, oval with integral waste fitting, 1-1/2 inch with polypropylene trap.

PROCESSED WATER SYSTEMS FOR LABORATORY FACILITIES

SYSTEM DESIGN
When program needs for new campus facilities require specially treated water supplies (e.g., deionized water for laboratory needs), these needs shall be met by providing on-site treatment systems or by expanding and connecting to the Campus centralized supply system. Such systems may include carbon filters, water softeners, reverse osmosis units, ion exchange systems, and ultraviolet light disinfection systems with ultra filtration of 0.2 microns.

Life-cycle costing shall be used to select system components (e.g., the use of resin beds vs. reverse osmosis units). Consideration should also be given during design for future needs in the facility and/or adjacent areas to allow for future expansion of local water treatment devices to meet higher flow and/or water quality requirements. Leased systems shall not be used to meet new facility needs.
Deionized water systems shall be designed to provide for a 1 megohm system unless otherwise required by the University. The system shall be recirculating.

**PIPING, JOINTS, FITTINGS AND UNIONS**
Pipe, fitting, unions and control valves manufactured of polyvinyl chloride PVC, Gray Standard Schedule 80 manufactured specifically for deionized water service. Metric sizes are not acceptable. Pipe shall be sterilized and capped prior to shipment. Fittings, unions and valves shall be sterilized and individually packaged after production. Joining shall be by socket weld, procedure as recommended by pipe manufacturer. No threaded joint or flexible connection will be permitted.

**VALVES**
Control and Bench Valves: Ball type with tapered sockets with ball and seat compatible with piping materials. Use aluminum coupler to connect to bench valve. 

**SUPPORTS**
Piping 2 inches and smaller and all horizontal piping shall have continuous 16-gauge galvanized sheet metal trough support or maximum 2 foot support spacing system.

**CLEANING**
All pipe, fittings, valves, and system-related materials shall be cleaned before use. Minimum requirements for cleaning procedures are:
1. Alconox detergent and 30 percent hydrogen peroxide cleaning agents.
2. Circulating pump.
3. 1 percent potassium permanganate testing solution.
4. The deionizer equipment may be used for cleaning the piping system.

**ULTRA PURE DEIONIZED SYSTEMS**
Piping, joints and fittings: Unpigmented (natural) polypropylene, copolymer Type 1, Schedule 40 butt-fusion and/or socked fusion. The system shall be recirculating through deionized polishing bottles. The entire system shall be sterilized. For bench valves for ultra pure water, use Chicago 828PVDF (solid PVDF valve), or equal.