SECTION 23 60 00 - LABORATORY PIPING SYSTEMS

PART 1 - GENERAL

1.1 SYSTEM DESIGN REQUIREMENTS

A. Air Systems:
1. Control air shall be provided from individual building air compressors. Control air compressors shall be oil free dual motor/compressor type rated at 150%.
2. Control air must be clean and dry. Compressor must be filtered and dried. Air drier may be refrigerated or desiccant style. Provide bypass piping and valves for servicing dries and filters and tank with control air system in operation.
3. Oil separator shall be sized to accept one crank case full of oil.
4. BAS shall monitor system.

B. Process or Lab Air System:
1. Process air is not available from a campus central air system. A building duplex compressor will be as the preferred source.
2. 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.
3. Piping systems shall be zoned appropriately and be provided with zone isolation valves. Compressed air piping should be sized on the basis of number of outlets, using a figure of 0.5 cfm at 40 psig per outlet. Diversity will vary from 100% simultaneous use in student labs to 20% to 30% in research labs. System loss should not exceed 5 psig loss at estimated demand. Any continuous demands shall be to the above quantities.
4. BAS shall monitor system.

C. Vacuum Piping System:
1. Vacuum piping should be sized on the basis of inlets. Use a figure of 1 cfm per outlet and 40% simultaneous use for typical laboratory rooms.
2. Friction loss should not exceed 5 inches of mercury column drop at estimated demand of system. The above should be modified to meet special conditions and types of rooms or service
3. Extend vent for vacuum pump up thru the building roof.
4. BAS shall monitor system.

D. Distilled or Deionized (DI) Water Systems:
1. Laboratory areas may require distilled or DI (deionized) water systems. The water still may be provided by the Department or furnished by the project. The still may be steam or electric powered depending upon demand and availability of steam. Utilities shall be provided by the project to the still which include domestic cold water, electrical power and steam. The distribution system shall be polypropylene Schedule 40 piping from tank to laboratory benches with appropriate gooseneck faucets made of, or lined with, polypropylene or other inert material. Isolation valves shall be provided at all branches for servicing and all DI water outlets.
2. Laboratory areas may require DI (deionized) water systems. The distribution system shall be polypropylene pipe with socket weld fuse joints with mechanical joints on all service branches. The DI cartridge systems will be provided and serviced by a vendor under existing purchase order contracts. The quantity and quality of DI water shall be established by the user in cooperation with the vendor through the University Project Manager. System shall have the ability to provide 18.0 megohm/cm quality water. Minimum water quality to users shall never be below 1.0 megohm/cm. Utilities shall be provided by the project to the DI system which includes domestic cold water and an electrical power outlet. Sometimes the DI system will be located in laboratories other times it may be centrally located in an equipment room. The distribution system shall be polypropylene Schedule 40 piping to laboratories with appropriate gooseneck faucets made of, or lined with, polypropylene or other inert material. The system will be under domestic water pressures or pump

pressure if not a gravity feed system to supply the system with specified psi at each user point. Isolation valves shall be provided at all branches for servicing and all DI water outlets.

3. Systems shall be automated to produce water within the required parameters. There shall be no less than 40 psi pressure at every user point. Circulate water at no less than 3 feet per second, with a maximum dead leg of 3 times the pipe diameter. Provide isolation valving at each service branch. All deionizing tanks shall be exchangeable for off-site recharging to include a backup bank of tank(s) with valving on a hard-piped manifold. Controls will be electro-mechanical in nature, with user serviceable parts. A dry contact for "no flow" alarm will be provided for connection to BAS systems. Pumps shall be stainless steel in construction. All control panels must be UL Listed and enclosures will be NEMA-4 rated. Isolation valving must be installed so any serviceable part can be bypassed and serviced without a total shutdown of the system. Pressure gauges will be installed at inlets and outlets of filters and pumps which will be user serviceable with a gpm gauge for a running total of DI water produced. Storage tanks will be polyethylene (HDPE) type, with a convex bottom. A spare parts list will be furnished with each installation, including a list of sources for their purchase.
4. Provide a resistivity monitor on the supply and return side of the DI system. Provide sampling valves at all major water processing equipment including, but not limited to, water softener, carbon filter, reverse osmosis, UV, ultra filter, and deionization
5. BAS shall monitor system.

E. Nitrogen Systems
1. General: All piping, fittings, valves, outlets, and any equipment through which medical gas or vacuum passes shall be supplied by the manufacturer especially cleaned and prepared for medical gas service in accordance with CGA Pamphlet G-4.1 and received labeled and sealed on the jobsite. On-site cleaning is not acceptable. Any prewashed item on which the seal has been broken before installation shall be removed from the site and shall not be used on this project.
2. Above Ground Piping: Seamless medical gas copper tubing, Type L, hard temper, ASTM Designation No. B-819 bearing one of the following markings: OXY, MED or OXY/MED.
3. Copper Tubing Fittings: Wrought copper solder-joint (95-5 fin antimony no lead) pressure fittings for brazed joints, ANSI Designation B16.22.
4. Valves: Union type three-piece construction, screwed, 400 lb. rated, with teflon seat, seals, packing, and chrome plated brass ball with service identification on valve handle.
5. Protective Casing for Under Ground Piping: Encase piping in a Schedule 40 galvanized steel airtight casing coated with extruded high density polyethylene coating applied with hot thermoplastic adhesive on clean pipe. X-Tru-Coat by Pipe Line Service Corporation, General Coatings, Inc. Field Joints, Fittings: Wrap with coal tar resin tape. Provide isolation supports between the pipe and casing at 6'-0" on center.
6. Protective Casing for Above Ground Piping: Encase piping in a Schedule 40 galvanized steel airtight casing where piping is installed in hazardous areas or areas subject to damage. Provide isolation supports between the pipe and casing oat 6'-0" on center.
7. Brazing Alloy and Thread Sealant: Brazing filler metal ANSI/AWS A5.8 with a melting temperature in excess of 1000°F (538°C).
8. BAS shall monitor system.

F. Liquid Nitrogen Systems
1. Piping: The piping system shall be a flexible stainless steel static vacuum insulated system - VBS Industries StatiFlex system. Piping shall consist of two corrugated stainless tubes inside one another separated by a multilayer superinsulation and laminar radiation shielding. Piping shall have a clear plastic outer protective covering for abrasion resistance.
2. Valves and other fittings: All pipe sections shall be continuous lengths up to sixty feet or as the layout specifies and joined together with bayonet couplings. Field welded joints are not permitted. Components such as bayonet couplings, tee assemblies and point of use valves shall be rated for cryogenic service and of the same manufacture as the cryogenic piping manufacturer.
3. Cool-down losses for piping shall not exceed 8 btu's per foot and steady state losses for piping shall not exceed 1 btu per foot per hour.

4. Piping drops to lab equipment shall terminate with gas trap end assembly, bronze extended bonnet cryogenic valve with integral safety relief valve assembly and vacuum insulated stainless steel flex hose for equipment connection.
5. BAS shall monitor system.

G. Animal Watering Systems
1. An automatic watering system to all animal housing rooms.
2. Water is RO with acidification.
3. Automatic watering system is flow thru or filtered recirculation system.
4. Stainless steel manifold distribution designed in a way to prevent “dead legs.”
5. System shall be equipped with a programmable flush system for each rack and be centrally monitored for pressure or leaks.
6. System should be designed to include treated storage tanks that are sized accordingly to provide minimum of 48hours of animal drinking water (when facility is at full capacity) in an emergency.
7. BAS shall monitor system
8. Provide Edstrom or SE Labs.

H. Medical gas piping and compressed air piping shall be:
1. Seamless ASTM B-819, type K or L hard drawn seamless medical gas copper tubing.
2. Fittings shall be wrought copper, brass or bronze designed expressly for brazed connection, compliant with ANSI B16.22.
3. Pipe (Tube), fittings, valves, and other components shall be specially cleaned for oxygen service in a facility equipped to clean, rinse, and purge the material in accordance with the requirements of NFPA 5.1.10.1.1 and received on job site cleaned and capped. On site cleaning of the interior surfaces of tubes, valves, fittings, and other components is not allowed.
4. Brazing alloy shall be BCuP-5 Brazing alloy or equivalent alloy with at least 1000 degree F melting point.
5. O2 piping to be certificated in accordance with NFPA and current Code.

I. Gas/Cryogenic Tanks:
1. Shall conform to UFC Article 75, NFPA 43A, 50, 50B and 59A (liquefied natural gas), OSHA 29CFR1910.101, 29CFR1910.102, 29CFR1910.103 and 29CFR1910.104

J. Compressed Gas Tanks (Unfired Pressure Vessels and Includes Air Receivers):
1. Shall conform to UFC Chapter 80, NFPA-43C (gaseous oxidizing materials), NFPA-50 (oxygen), OSHA 29CFR1910.101 (general), OSHA 29CFR1910.103 (hydrogen), OSHA 29CFR1910.104 (oxygen), OSHA 29CFR1910.105 (nitrous oxide), OSHA 29CFR1910.111 (anhydrous ammonia), OSHA 29CFR1910.169, ASME Boiler and Pressure Vessel Code, State Health Department for Drinking Water Swimming Pool Regulations (chlorine).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers::
1. DI faucets:
   a. Water Saver (preferred)
   b. Cambridge Brass

2.2 MATERIALS GENERAL

A. Air Systems Piping:
1. Air piping shall be hard drawn type “L” copper tubing with wrought copper fittings and lead free soldered joints..

B. Deionized (DI) Water:
   1. Provide DI water piping system that is looped with a circulation pump. Complete system shall be unpigmented polypropylene with polypropylene stainless steel valves and accessories.
   2. The system shall provide 18.0 and not less than 1.0 megohm/cm quality water. Provide complete system including, but not limited to, the following:
      a. One automatic backwashing granular activated carbon filter. Filter shall be used for chlorine and organic removal at a flow rate of 30 gpm.
      b. Supply one, cartridge type, sediment filter housing constructed of 316 SS, electro-polished. Housing shall use one micron (minimal) filler cartridges. The empty housing flow rate shall be 30 gpm at a pressure loss of less that 2 psi.
      c. Supply sufficient grain tribed deionizers. Each tribed deionizer shall consist of one cation, one anion (strong base), and one mixed bed.
      d. Tanks shall be stainless steel or constructed of non-corrosive fiberglass surrounding an inner-molded lining of ABE plastic. Supplies shall be capable of regeneration of resins within the tank so that no U. of C. Resins are mixed with other resins. Supplier shall have a 24 hour emergency response capability include 1,000,000 ohm quality indicator light. Tank fittings shall be quick-disconnect, union style, and be made of inert materials.
      e. Supply enclosed annular head, flat bottom storage tanks. Tanks shall be factory steam cleaned. Tank shall come complete with all necessary fittings and shall be vented.
      f. Supply one level control with high level cutoff, low level pump cutoff, and mid-level fill. Mid level will energize n/c solenoid on the make-up line and cut power to the DI water recirculation pump. High level will close solenoid valve and start DI water recirculation pump.
      g. All necessary pumps
      h. Glycerine filled gauges with ss stems.
      i. Quality Monitor/Controller 35,000-5,000,000 ohm/cm 0.1 constant cell, meter, 10' cord.
      j. All necessary controls and hardware to make system complete.
   3. Polishing units will be required at the lab outlet

C. Process or Lab Air System Piping:
   1. All process or lab air lines shall be Type “L” copper with brazed joints, with silver braze material.
   2. All process or lab air piping to be silver soldered.

D. Vacuum Piping:
   1. All vacuum piping shall be Type “L” copper with brazed or soft solder joints.

E. DI Socket Welded Piping:
   1. Polypropylene Pipe For D.I Water Systems
      a. All high-purity water piping as shown on drawings shall be socket-fused, virgin natural polypropylene (containing no regrind material) as manufactured by IPEX. The complete system of piping, valves, fittings, faucets, pipe supports and fusion equipment shall be supplied and warranted by a single manufacturer.
      b. Physical dimensions and properties of Enpure PP Schedule 40 and 80 Pipe and fittings shall meet the requirements of ASTM D 1785 and CSA B 137.3.
   2. Polypropylene Material
      a. Piping shall be manufactured in 10’ or 20’ (3m or 6.1m) lengths to Schedule 40 and Schedule 80 dimensions from virgin, unpigmented, Type 2 high-impact copolymer polypropylene conforming to ASTM D 4101, using no antioxidants or plasticizers. Piping shall be capped at each end and boxed for protection and cleanliness at the point of manufacturing.
   3. Polypropylene Fittings For D.I. Water Systems
      a. Fittings shall be manufactured from virgin, unpigmented Type 2 high-impact copolymer polypropylene conforming to ASTM D 4101, using no antioxidants or plasticizers. Fittings shall be designed for socket fusion utilizing socket fusion tools and shall have a working design pressure of 150 psi at 73ºF (1,000 kPa @ 23ºD). All fittings shall be packaged in polybags at the point of manufacturing to preserve fitting cleanliness.

4. Polypropylene Valves
   a. All valves shall be manufactured from virgin, unpigmented type 1 Homopolymer polypropylene conforming to ASTM D 4101, using no antioxidants or plasticizers that could compromise water quality. Valves shall be designed for socket fusion utilizing IPEX socket fusion tools and shall have a working design pressure of 150 psi @ 73ºF (1,000 kPa @ 23ºC). All ball valves shall be double-blocking type with 0-ring cushions under the PTFE seats, in-line micro adjustment capability and incorporate a spanner wrench in the handle. All diaphragm valves shall be weir-style featuring smooth (non-drilled) GRF bonnets with integrated fasteners (for cleanliness) and rising position indicator. All valves with EPDM diaphragms shall feature concentric ridges on valve body and smooth diaphragms. All valves with PTFE diaphragm shall feature machined (smooth) bodies and rigid PTFE diaphragms for positive seal and longer cycle life. All ball check valves shall be single union design with micro adjustable locking seat carrier.
5. Fusion Equipment
   a. All piping supports shall incorporate Cobra clips manufactured from U.V. stabilized polypropylene and designed to allow free axial pipe movement during expansion and contraction of a pipe system. Support spacings shall be to the manufacturer's recommendations for the design temperature of the system.
6. Joining Method
   a. Installation shall be in accordance with the contract drawings, the manufacturer's recommendations and the local building codes. The entire system shall be installed stress free and in proper alignment, with due allowance for expansion and contraction.
   b. The water-testing requirements on any complete piping system vary dramatically depending on the operating pressure, temperature, installation conditions, jointing method and the proposed service medium. If the testing is not determined by the engineer or governed by regulatory code, the manufacturer should be contacted.
   c. All polypropylene pipe shall be jointed by the following methods:
      1) Hand Held Tool.
      2) Bench Fusion Machine completion of the project.
      3) Contractor to provide both a hand held tool and bench fusion machine to the university at completion of project.
      4) When any of the following is required – larger sizes, high volume joints per day or absolute consistency of the welds – the use of a bench fusion machine (manual or hydraulic) is recommended.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Plumbing: No lead solder shall be utilized.

B. All piping installed per most recent IPC.

3.2 HVAC Control Air Systems:

A. Provide instrument air tubing with check and hand valves to expansion tanks with Schraeder fittings and hose.

B. Leak-test the pneumatic system mains to 150% of maximum system pressure for 24-hours. Check calibration of instruments. Recalibrate or replace.

3.3 TESTING, CLEANING, AND CERTIFICATION

A. All process or lab air system piping shall be sterilized prior to use.

B. System Disinfection
   1. On system startup provide disinfection of the entire high purity water system. For the reverse osmosis central system, provide for disinfection to be the responsibility of the water system manufacturer. For the distribution piping, disinfection is the responsibility of the Mechanical Contractor, coordinated with reverse osmosis system manufacturer.
   2. Achieve disinfection by maintaining a concentration of not less than 200 ppm of sodium hypochlorite for a minimum contact time of four hours or a 1% solution of Minncare cold sterilant for 1 hour. Verify concentrations at all drops during dwell time. Then flush and fill the system with reverse osmosis/DI water only. Test all drops to ensure the system has been properly flushed.
   3. After system and distribution disinfection, bacterial samples shall be taken from the storage tank, after the final filters and at four points of use, one point being the last distribution point before returning to the storage tank, and one being the furthest point from the RO/DI equipment room.

END OF SECTION 23 60 00