SECTION 220000 – PLUMBING SYSTEMS

1.0 Valves

A. ASME compliance:

1. ASME B1.20.1
2. ASME B16.1
3. ASME B16.10
4. ASME B16.34
5. ASME B16.18
6. ASME B31.9

B. All branch mains shall be provided with shutoff valves to permit servicing of systems without affecting other areas of the building. As a minimum, each toilet area (men's or women's) shall be provided with isolation valves.

C. Up to Two and One-half (2-1/2) inches: Full port, 2-piece, bronze body ball valves with teflon seat conforming to MSS SP-110.

D. Three (3) inches and above: Gate valve with flanged connections, non-rising steam, bolted bonnet and bronze trim, conforming to MSS SP-70. Select class to meet service.

E. Check valves conforming to MSS SP-80 shall be swing type bronze body up to 2-1/2 inches. Above 2-1/2 inches use water, bronze body type designed for installation between ANSI, B16.1 flanges.

2.0 Domestic Cold Water System

A. Domestic cold water service shall be provided from a connection to the existing city water system. Triplex constant pressure booster pumps (if required) shall be provided with each pump sized at 40% of the estimated requirements. Variable speed drive similar to the Delta Pak system from Delta P Systems shall be provided for all systems.

B. Piping shall be sized to maintain a minimum flow of 25 GPM and a minimum pressure of 35 psig at the farthest flush valve and 30 psig at the hydraulically most remote safety shower. Water velocity in the distribution piping system will not exceed 6 feet per second and provisions shall be made to reduce any water hammer with water hammer arrestors. All of the piping in the domestic water system will be insulated. All branches off the domestic cold water distribution main providing service to mechanical shall be provided with backflow preventers.

C. Refer to Section 221116 for piping materials.

3.0 Domestic Hot Water System

A. The maximum hot-water temperature produced will be 140 degrees F with service to laboratory sinks, lavatories, showers, washdown stations, general purpose sinks, service sinks, and other specific equipment mixed to 120 degrees F as required.

B. For kitchen equipment, dishwashers, cage, rack and glassware washers and hose station requirements, 140 degree F water shall be provided. Any requirements for higher temperature water shall be provided by local water booster heaters provided with the equipment.

C. Domestic hot water shall be produced by duplex domestic hot water generators. Where steam is available provide instantaneous water heaters. Additionally, where steam is available, the steam condensate should be used to preheat the incoming cold water to the hot water generators. The generators shall be sized to satisfy the domestic fixture and equipment demands. Hot water generators shall be designed, with each generator capable of satisfying a minimum of 100% of system demand upon the failure of any single hot water generator.

D. Special consideration must be taken into account for the large stop / start water demands of washers. Systems serving these must be designed so that the controls response time is rapid so as not to over shoot or under shoot the set-point by more than +/- 5 F. A buffer or reservoir tank may be needed to satisfy this requirement.

E. Systems shall be carefully designed to provide design temperature hot water within 5 seconds at any system outlet.

4.0 Sanitary Drainage System

A. Sanitary drainage, waste and vent system shall be provided including waste and vent systems from all toilets, lavatories, service sinks, non-process floor drainage, etc. Sanitary drainage will be connected directly into the site sanitary sewer system without treatment.

5.0 Laboratory/Process Waste and Vent System

A. Laboratory/process waste and vent system shall be provided for all lab fixtures, equipment and floor drains located in lab and process areas. Laboratory/process waste shall be a dedicated system within the building and be connected to the site sanitary system. Sampling capability for effluent testing shall be provided prior to connecting to the site sanitary system. On a project by project basis, the need for a chemical neutralization system before connection into the site sanitary sewer system shall be evaluated.

B. Waste systems shall not be required to filter, distill, incinerate or otherwise remove any toxins, particulate, solid, radioactivity, or heavy metals. Only pH neutralization and/or dilution will be considered.

C. Treatment of biological waste shall be via dedicated treatment systems before discharging into the site sanitary system.

D. Toxic, radioactive, solvent or high concentration wastes will be disposed through local, “in-lab” safety containers, without use of piped waste systems.

6.0 Storm Water Drainage System

A. Storm water drainage system shall be provided for all roof and area drains and be connected into the site storm system.

B. Parking area drains shall connect into the storm drainage system. Oil and sand interceptors shall be provided for the storm drainage from the parking facilities.

C. Storm water drainage overflow system shall be provided for all roofs which cannot support the buildup of rainwater caused by an obstructed primary roof drain and where scuppers are not provided.

D. If required, sanitary, laboratory/process or storm drainage from lower building levels shall be lifted to the main sanitary line and draining by gravity to the site sewer system. A duplex

sewage ejector pumping system shall be used for this purpose. Each pump shall be sized for a capacity of 100 percent of the load.

E. Sump pumps shall be provided at the bottom of elevator shafts where floor drains cannot be installed. Sump pumps will be supplied with an oil shut-off switch or an oil interceptor shall be installed in the pump discharge pipe if the elevator is hydraulic. Discharge shall connect to the sanitary system.

7.0 Laboratory safety equipment (eyewashes and emergency showers) shall be supplied with TEPID water, 60-100 ° F.

8.0 Rooms that store laboratory gas cylinders will have oxygen sensors connected to alarms and where possible connected to the building automation system.

9.0 Natural Gas System

A. A natural gas system shall be provided to supply laboratory outlets, kitchen equipment and mechanical equipment requiring this service. Natural gas shall be extended into the facility from a connection to the existing or new site main and be distributed at 1 in. wc pressure.

B. Capacity for the piping system shall be based on actual equipment demand, plus 7 cfh per laboratory outlet with diversity factors applied based on the number of outlets. Diversity factors are as follows:

NATURAL GAS SYSTEM DIVERSITY FACTORS		
Number of Outlets	Use Factor - Percent	Minimum Outlets
1-8	100	---
9-16	90	9
17-29	80	15
30-79	60	24
80-162	50	48
163-325	40	82
326-742	35	131
743-1570	30	260

C. An AGA approved valve shall be provided at each lab module for shut-off of natural gas supply to lab. Valves shall not be located above ceiling spaces.

D. Laboratories with two or more gas outlets shall have an emergency shut-off valve wall mounted push button in an accessible location within the laboratory or adjacent to the laboratory's egress door and identified. The push button shall shut off a gas solenoid valve located in gas main serving the laboratory.

10.0 Compressed Air System

A. A compressed air system shall be provided to supply laboratory outlets, outlets in mechanical equipment rooms and equipment requiring this service. Oil-free Grade D compressed air shall be distributed throughout the facility at 100 psig. Branches to equipment will be provided with pressure regulators to reduce system pressure as

required for specific equipment. A maximum pressure of 35 psig will be supplied to laboratory outlets.

B. Compressed air shall be dried to 35 degrees F or minus 40 degrees C dew-point for laboratory equipment applications prior to distribution. The distribution system shall be designed based on one (1) scfm per outlet, with diversity (based on intended use) factors applied based on the number of outlets, plus actual demands of equipment requiring this service. Diversity factors are as follows:

COMPRESSED AIR SYSTEM DIVERSITY FACTORS		
Number of Outlets	Use Factor - Percent	Minimum Outlets
1-2	100	---
3-12	80	3
13-38	60	10
39-115	40	25
116-316	30	50
317-700	20	95

C. Installed equipment shall provide for a minimum of 67 percent system capacity upon the failure of any single compressor or drier.

D. Air compressors shall be oil free air cooled.

E. Air shall be filtered centrally to 5 microns with additional branch or point of use filtration where necessary. Redundant filtration devices shall be provided for on-line maintenance.

11.0 Nitrogen System

A. A gaseous nitrogen system shall be provided to supply laboratory outlets and equipment requiring this service. Nitrogen shall be delivered and distributed either from central manifolded cylinder systems or from liquid nitrogen storage and vaporizer systems. For manifolded cylinders applications, automatic changeover capabilities shall be provided between cylinders. Local alarms shall be provided.

B. Gaseous nitrogen shall be distributed to laboratories at 125 psig (or optional pressure), with 35 psig maximum at laboratory outlets.

C. The distribution system shall be designed based on one (1) scfm per outlet, with diversity factors applied based on the number of outlets, plus actual demands of equipment requiring this service.

NITROGEN SYSTEM DIVERSITY FACTORS		
Number of Outlets	Use Factor - Percent	Minimum Outlets
1-5	100	---
6-12	80	5
13-38	60	10

39-115	40	25
116-316	30	50
317-700	20	95

12.0 Special Gas Systems

A. Other laboratory gases (Argon, Carbon Dioxide, Oxygen and any other specialty gases) shall be delivered, handled, and distributed from cylinders on a local basis, via central manifolding and distribution systems (where practical) based on system capacity requirements and user locations or via bulk storage tanks. Gases shall be distributed from protected and ventilated areas. There shall be separate areas provided for storage of flammable and oxidizing gases in cylinders. For manifolded cylinder applications, automatic changeover capabilities shall be provided between cylinders. Local alarms shall be provided.

13.0 Process steam shall be provided to process equipment as required. Maximum pressure and other specific requirements shall be evaluated based on the equipment selected on a project by project basis.

14.0 Laboratory Vacuum System

A. A dry vacuum system shall be provided for all lab areas as required.

B. Vacuum shall be provided at a minimum of 25 in Hg at the furthest inlet (to be confirmed with users group). System shall be designed based on one (1) scfm per inlet. Diversity factors shall be applied based on the maximum number of inlets. Diversity factors are as follows:

LABORATORY VACUUM SYSTEM DIVERSITY FACTORS		
Number of Inlets	Use Factor - Percent	Minimum Inlets
1-5	100	---
6-12	80	5
13-33	60	10
34-80	50	21
81-150	40	40
151-315	35	61
316-565	30	111

C. Installed equipment shall provide 67 percent standby capacity upon the failure of any single vacuum pump.

D. Vacuum pumps are to be located below the area they serve.

15.0 Purified Laboratory Water System

A. Laboratory grade water conforming to ASTM standards for Type II reagent grade water shall be provided for general laboratory use.

B. Pending the review of a water sample analysis, a system utilizing pretreatment by sediment and carbon filtration, water softening (and brine tank), distillation, ion, exchange, reverse osmosis, continuous deionization unit (CDI), or a combination thereof, followed by polishing and .45 micron membrane filters shall be provided as required to produce 1.0 meg-ohm-cm quality water as a minimum.

C. The water distribution loops shall have continuous flow. Dead legs of more than 6 pipe diameters are not permitted. Pumps shall be redundant. System shall also incorporate a storage tank and a UV light sterilizer. Resistivity shall be monitored in the return line to the storage tank. A method for system sanitization shall be provided with sample points as required to permit testing of the water. All of the water system equipment shall be located in a mechanical room. Local point-of-use laboratory polishing units shall be provided if required to produce water of higher quality.

D. The piping capacity shall be based on an instantaneous demand of 0.5 gpm per lab outlet (with applied diversity factor) plus equipment demands. Pretreatment equipment capacity shall be based on 2 gph per lab plus equipment demands.

E. Serious consideration should be given to the use of local pure water generators only with no central system. This has been the system of choice for many recent Penn projects.

16.0 Vivarium Systems

A. Vivarium water system shall be supplied from the laboratory water system or have a dedicated system supplied from the domestic water service. The system shall be equipped with a reduced type (RPZ) backflow preventer.

B. Hose stations - see section 221119-14

C. Electric Flush Valves and Control Panels for Flushing Drains and Large Animal Room Trenches

1. Provide concealed flush valve, rough brass, 1 inch IPS wheel handle back check angle stop, adjustable tailpiece, vacuum breaker, 1 inch female IPS union outlet (no flush connection), with 24 V ac solenoid operator and electric pushbutton (remotely located). Exposed parts shall be chrome-plated.
2. Electric pushbutton for each room shall be grouped together in a stainless steel control panel. Panel shall be furnished with prewired momentary contacts and 120 V/24 V ac transformers as required. Transformers shall be sized for simultaneous solenoid operation plus 20 percent spare capacity. Panels shall be NEMA 4 and UL rated.

D. Large animal room trenches shall either have a drain provided in the center of the trench and flushing nozzles at each end or on smaller trenches, the drain provided at one end and the flushing nozzle at the opposite end. The flushing nozzle shall be a "Barco" stainless steel nozzle or equal.

E. Vivaria shall be located on the buildings upper floors where possible to avoid the need for sewage ejector lift stations. If lift stations are required, provide stainless steel cutter pumps with turbulence flush valves and basin wash down devices.

17.0 Hazardous Waste Treatment Systems

A. The requirements for a laboratory waste neutralization system to treat any laboratory waste system to pH levels suitable for discharge to the sanitary sewer system shall be evaluated on a project by project basis.

B. The requirements for a biohazard waste treatment system to treat any biohazard waste shall be evaluated on a project by project basis. The treated waste shall be discharged to the sanitary sewer system.

18.0 Capping of Lines: Whenever demolition of existing plumbing or piping systems occurs, no lines shall be left open ended. All lines shall be terminated with either a valve and a cap or plug, or with just a cap or plug. The cap or plug shall be installed to withstand the flow and pressure of the line that it is terminating in the event that the line is reenergized.