PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 220500 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. Provide all labor, materials, equipment and services necessary to furnish and install a complete process piping system, as indicated or specified. Install and deliver all systems complete, in perfect working order, and in full accordance with the intent and meaning of the drawings and specifications. The work, in general, consists of, but is not necessarily limited to, the following:
1. A complete acid waste and vent piping system to serve lab spaces.
2. A complete industrial cold water (soft water) piping system.
3. A complete compressed air piping system.
4. A complete process vacuum piping system.
5. A complete Reverse Osmosis (RO) water piping system.
6. Testing of all piping systems as specified hereinafter.
7. Preparation of as-built drawings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Division 03: Concrete

B. Section 220500: Basic Plumbing Materials and Methods

C. Section 220700: Plumbing Insulation

D. Division 26: Electrical.

1.4 QUALITY ASSURANCE

A. Comply with codes and standards required for proper system installation.

1.5 WORKMANSHIP

A. Install all work pertaining to process piping systems as close as possible to layout shown on the drawings. Employ skilled mechanics to install all systems in a manner acceptable to the owner.

1.6 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01 requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store/protect products under provisions of Division 01. Protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products - remove from project site.

PART 2 - PRODUCTS

2.1 ACID AND FLUORIDE WASTE & VENT

A. Piping:
1. Carrier: Schedule 80 polypropylene ASTM D4101 with electric fusion joints, flame retardant for above grade Enfield.
2. Containment: Schedule 80 white PVC piping with clamshell fittings and centralizers, R & G Sloane “Contain-It”.
3. Provide leak detection tees, 50 ft. on center.

2.2 INDUSTRIAL COLD WATER (SOFT WATER)

A. Piping: Type "L" hard drawn copper, conforming to ASTM B88.

B. Fittings: Provide wrought copper type fittings conforming to ANSI A40.2 for all connections to copper piping.

C. Solder
1. Lines 1/2" through 2": Use 95/5 solder with suitable flux.
2. Lines 2-1/2" and Larger: Use Aircoil 45, or other silver bracing alloy of equivalent melting point and physical properties. Use Aircoil Flux, or equal suitable to bracing alloy.

2.3 COMPRESSED AIR PIPING

A. Piping: Type "L" hard drawn copper tubing per ASTM-B-88.
1. Fittings: Provide wrought copper fittings conforming to ANSI-A40.2. Clean, free from oxide and corrosion.
2. Braze Alloy: SilPhos 15 or HP-101 B CU2 braze alloy with residual matter less than 0.015% (no flux shall be used).
3. Valves
a. Ball Valves: Socket end for braising, 2" and smaller; ANSI B16.34, 400 psi ASTM B16 brass 2-piece body, reinforced Teflon seats and seals, conventional part, blow out proof brass stem, stainless steel ball and extended solder cups.
b. Butterfly Valves: Lug type 2-1/2" and larger; MSS SP-67, ductile iron body, ASTM A395, stainless steel disc, EPT sleeve and o-rings, lever operated; over 6" chain operated.
c. Check Valves: Nibco, Grinnell. Spring type check valves.

2.4 PROCESS VACUUM SYSTEM

A. Piping: Category 3 Type "L" hard drawn copper tubing per ASTM B 88.

B. Fittings: Brazed or soldered fittings complying with ASTM B16.22.

C. Joints

1. Brazed, soldered, threaded, flared or compression type.

2.5 RO WATER

A. Piping: Polyvinylchloride (PVC) Schedule 80, Type 1, Grade 1, conforming to ASTM D 1785.

B. Fittings: “Chemtrol” PVC Type 1, Schedule 80, Grade 1 designed for socket weld joints.

PART 3 - EXECUTION

3.1 ACID WASTE AND VENT

A. Clean the end of the pipe with dry rag and remove all burrs and moisture. Install pipe and fittings in strict accordance with manufacturer's written instructions.

B. Clamshell fittings shall be installed with epoxy cement by same manufacturer as fittings. Epoxy to be carefully applied as not to interfere with leak detection cables.

C. Test acid waste by filling with water to highest point of system and test with 10 feet head of water held for four (1) hours.

3.2 INDUSTRIAL COLD WATER (SOFT WATER)

A. Installation: Extend water piping to all outlets and equipment. Provide shut-off valves as illustrated. Provide capped or plugged valved outlets where indicated for future equipment connections.

B. Sterilization: Sterilize the entire water distribution system thoroughly with a solution containing not less than 50 parts per million of available chlorine. For the chlorinating material use sodium hypochlorite solution conforming to Federal Specification 0-8-441, Grade D, and introduce into the system in a manner approved by the Owner. Allow the sterilizing solution to remain in the system for a period of 8 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, flush the solution from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million, unless otherwise directed.

C. Testing: Test industrial cold water system with a minimum of 125 psi hydrostatic pressure and hold for four (4) hours. Perform testing prior to sterilization.

3.3 COMPRESSED AIR (COPPER)

A. Installation
1. During brazing and soldering, all gas lines must be continuously purged with nitrogen gas allowed to escape to atmosphere through a restrictor. No brazed joint can be less than six inches away from the end of the purge line, which may require the use of an extension. For each purge restrictor used, use a minimum flow of 10 to 15 CPH of N2 purge gas, but in all cases use sufficient purge gas to prevent oxidation. Any line showing traces of oxidation shall be removed occasionally to assure compliance with accepted cleaning and installation procedures. The section removed shall be no more than three feet long and amount to no more than three percent of the total piping system.
2. No more than 60 feet of pipe to be assembled on line prior to brazing and soldering.
3. Place caps with 1/8" diameter purge hole restrictors on each exit of the section of the line being fabricated.

4. A minimum of six inches of purge extension is required for all brazed joints.
5. Insert pipe full depth of the fitting.
6. Piping shall be run as direct as possible and run from nearest terminal valve. Terminal valves shall not be overloaded. Accessibility to valves must be considered.
7. Valve location to be staggered to allow space to operate valve.
8. All joints which show evidence of overheating, cracking, poor penetration, or other defects of fit-up or workmanship shall be replaced, as directed by the Owner's representative.
9. If the system becomes contaminated due to fabrication technique, the contractor must replace the system at the contractor's expense, with fresh material.
10. Pipes shall be cut with ends square and true to size. Only new tubing cutters dedicated to this system, with sharp cutting wheels, with no oil or grease, shall be used. Remove burrs with deburring tool only, then purge to remove any chips left in pipe.
11. All joints in the piping, except those at valves or equipment requiring screwed connections, shall be made with fluxless type braze material.
12. Suitable adaptors shall be used for installation of valves and other equipment provided with threaded connections.
13. In joining fittings to 3/4" diameter tubing or smaller, the entire joint can be brazed in one simultaneous heating operation. When pipe and fittings are larger than 3/4" diameter, sectional heating is required.
14. No pipe dope shall be used on any screwed joints.
15. A section of tubing to be cut from a length shall be cleaned with an abrasive cloth sufficient for a joint area on each side of the intended cut-off point before the cut is made.
16. Support tubing and fitting as necessary to keep their axis straight and in line and maintain equal clearance around the tubing and fitting to permit uniform capillary action to have proper effect on alloy position.
17. Use of screwed joints shall be kept to an absolute minimum and where their use is indicated or required, they shall be made up with only Teflon tape.

B. Inspection: All equipment, materials, and installations shall be tested in the presence of the Owner or the Owner's representative. The Owner's representative reserves the right to have any joint in the piping system, which he suspects may be faulty or, as a part of a quality control program, to be cut out of the system by the contractor for inspection and testing. Should the joint prove to be sound, and above the quality control 3%, the owner will reimburse the contractor on a time and material basis, as specified in the general conditions of the contract. Should the joint prove to be faulty or the adjacent piping found to be uncleaned or oxidized, the destructive test will continue joint by joint until sound pipe is found.

3.4 VACUUM PIPING (COPPER)

A. Installation
1. Fabricate and install systems in accordance with ASME B31.1, MSS SP-69 and AWS WHB-2.9.
2. Install piping systems materials in accordance with manufacturer's instructions.
3. Fabricate pipe to measurements established on the job and carefully work into place without springing or forcing. Make adequate provisions for absorbing all expansion and contraction without undue stress in any part of the system.
4. Keep pipe, tubing, fittings, valves, equipment, and accessories clean and free of foreign material before being installed in their respective systems.

5. Purge lines with dry, oil-free compressed air after erection, but do not rely on purging for removing all foreign matter. Perform purging at a velocity greater than maximum normal-flow velocity and be approved by the Contracting Officer.
6. During the progress of construction, properly protect open ends of pipe, fittings, and valves at all times to prevent the admission of foreign matter. Place plugs or caps in the ends of all installed work at all times when connections are not actually under way. Ensure plugs are commercially manufactured products.
7. Install piping straight and true with approved offsets around obstructions with necessary expansion bends or fitting offsets essential to a

B. Inspection: All equipment, materials, and installations shall be tested in the presence of the Owner or the Owner's representative. The Owner's representative reserves the right to have any joint in the piping system, which he suspects may be faulty or, as a part of a quality control program, to be cut out of the system by the contractor for inspection and testing. Should the joint prove to be sound, and above the quality control 3%, the owner will reimburse the contractor on a time and material basis, as specified in the general conditions of the contract. Should the joint prove to be faulty or the adjacent piping found to be uncleaned or oxidized, the destructive test will continue joint by joint until sound pipe is found.

3.5 RO WATER

A. Installation: Extend RO Water piping to all outlets and equipment. Provide shut-off valves as illustrated. Provide capped or plugged valved outlets where indicated for future fixture connections. Comply with ASTM f 402 for handling solvent cements, primers, and cleaners. Make joints in accordance with ASTM D 2672.

B. Inspection: All equipment, materials, and installations shall be tested in the presence of the Owner or the Owner's representative. The Owner's representative reserves the right to have any joint in the piping system, which he suspects may be faulty or, as a part of a quality control program, to be cut out of the system by the contractor for inspection and testing. Should the joint prove to be sound, and above the quality control 3%, the owner will reimburse the contractor on a time and material basis, as specified in the general conditions of the contract. Should the joint prove to be faulty or the adjacent piping found to be uncleaned, the destructive test will continue joint by joint until sound pipe is found.

END OF SECTION