

SECTION 15210

GAS AND VACUUM SYSTEMS PIPING

PART 1 –GENERAL

1.1 SUMMARY

- A. Section includes pipe, pipe fittings, valves, and accessories for laboratory compressed air and vacuum. Vacuum pumps, air compressors, air dryers, and accessories are specified within this Bulk carbon dioxide, nitrogen and oxygen that will not be used for breathing air systems may use this specification for pipe, fittings systems, valves, and accessories.
- B. Related Sections:
 - 1. Section 02321 – Excavation : Execution requirements for pipe trenches and backfill specified by this section.
 - 2. Section 16150 – Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

- A. ANSI B40.1 - Gauges, Pressure and Vacuum, Indicating Dial Type-Elastic Element.
- B. ASME B16.3 (American Society of Mechanical Engineers) - Malleable Iron Threaded Fittings.
- C. ASME B16.26 (American Society of Mechanical Engineers) - Cast Bronze Fittings for Flared Copper Tubes.
- D. ASME B31.1 (American Society of Mechanical Engineers) - Power Piping.
- E. ASME B31.9 (American Society of Mechanical Engineers) - Building Services Piping.
- F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- G. ASTM A234/A234M – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- H. ASTM B32 - Solder Metal.

- I. ASTM B88 - Seamless Copper Water Tube (ASTM B88M - Seamless Copper Water Tube [Metric]).
- J. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration field Service.
- K. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe.
- L. MSS SP-80 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Bronze Gate, Globe, Angle and Check Valves.
- M. MSS SP-110 (Manufacturers Standardization Society of the Valve and Fittings Industry)
- N. Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- O. AWS A5.8 (American Welding Society) - Brazing Filler Metal.
- P. FM (Factory Mutual System) - Approval Guide.
- Q. FS WW-V-35 - Valve Ball.
- R. FS WW-V-54 - Valve, Gate, Bronze (125, 150 and 200 Pound, Screwed, Flanged, Solder End, For Land Use).
- S. Z. MIL-R-36557 - Regulator, Pressure, Medical Gas Administration Apparatus.
- T. MIL-V-82026 - Valves, Diaphragm, Stop.
- U. MSS SP-58 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Materials, Design and Manufacture.
- V. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
- W. MSS SP-80 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Bronze Gate, Globe, Angle and Check Valves.

1.3 SUBMITTALS

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate piping system schematic with electrical and connection requirements general assembly of components, mounting and installation details,

and general layout of control and alarm panels. Indicate detailed medical wall assembly drawings.

- C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- D. Samples: Submit one of each outlet.
- E. Design Data: Provide manufacturer's data sheets for all products to be used.
- F. Test Reports: Provide independent testing agency report showing that systems are complete, zone valves installed, alarm systems functional, and pressure and cross connections tests performed.
- G. Manufacturer's Installation Instructions: Submit hoisting and setting requirements, starting procedures.
- H. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- I. Manufacturer's Field Reports: Indicate systems are complete, zone valves installed, and alarm systems functional.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01770 – Closeout and Turnover Procedures: provide the following in addition to the requirements of.
 - 1. Project Record Documents: Record actual locations of equipment piping, valves, outlets and components.
 - 2. Operation and Maintenance Data: Submit assembly views, lubrication instructions, replacement part numbers and availability.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 99 in high purity installations.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETING

- A. Section 01330 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing Work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect equipment.
- B. Accept equipment on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- C. Protect piping and equipment from weather and construction traffic. Maintain factory packaging and caps in place until installation.

PART 2 –PRODUCTS

2.1 VACUUM AND COMPRESSED AIR PIPE AND PIPE FITTINGS

- A. Steel pipe is for use only on industrial compressed air systems. It may not be used in laboratories or after the air compressor. Steel pipe may be used for vacuum pump exhaust line. All piping must be metal for any system that operates over 5 PSIG. Piping between the compressor and the first isolation valve shall schedule 80 steel or Type L annealed copper.
- B. Steel Pipe: ASTM A53, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
 - 2. Joints: Threaded or welded to ANSI B31.1.
- C. Copper Tubing: ASTM B88 (ASTM B88M), Type L drawn.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, solder, Grade 95TA.
- D. Copper Tubing: ASTM B819, Type L annealed, Type ACR-OXY.
 - 1. Fittings: ASME B16.26 cast bronze.
 - 2. Joints: AWS A5.8 Classification BCUP-3 or BCUP-4 Silver Braze.

2.2 COMPRESSED AIR VALVES

- A. Ball Valves: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded or brazed ends.

- B. Air Outlets: Quick Connector: 3/8 inch brass, snap on connector with self closing valve, Style A.

2.3 AIR PRESSURE REDUCING VALVE

- A. Pressure Reducing Station: Consisting of automatic reducing valve and bypass, and low pressure side relief valve and gage. Provide oil separator where indicated.
- B. Valve Capacity: Reduce pressure from 200 psi to 30 psi, adjustable upward from reduced pressure.

2.4 COMPRESSED AIR CHECK VALVE

- A. Tubing check valve: brass body, brass seat, 316 stainless steel spring, 1/2 psi cracking pressure. Oxygen cleaned by manufacturer. TCV series valve, Check-All Valve Manufacturing or equal (no known equal).

2.5 COMPRESSED AIR PRESSURE REGULATOR

- A. At service point to laboratories provide an ASME rated pressure regulator. Regulator shall accept inlet pressures up to 500 PSI and shall reduce outlet pressure between 1 and 60 PSI. Outlet pressure shall be easily adjusted with hand operated valve configured for setting pressure between 1 and 60 PSI in 2 PSI increments. Manufacturer: Fairchild Model 10, Fischer-Rosemount, or equal.

2.6 ACCESSORIES

- A. Piping Identification: Pressure sensitive adhesive tape and decals, color and labeling to conform to Section 15075.

2.7 GAS OUTLETS

- A. Outlet Units: CGA V-5, Diameter Index Safety System (DISS), NFPA 99 non-interchangeable connectors, automatic valves, secondary check valves (except vacuum and evacuation outlets), and capped 3/8 inch (8 mm) tubing stubs for supply connections, color coded and labeled for intended service.
- B. Faceplates:
 - 1. Flush Outlets: Mount in galvanized steel boxes with stainless steel faceplate with Lexan cover, color coded with embossed labeling.
 - 2. Surface Outlets: Surface mount with color-coded plastic cover and [stainless steel] [chrome-plated] faceplate with Lexan cover, color-coded with embossed labeling.

2.8 AIR COMPRESSORS AC-1

- A. Sizes, type and capacity as shown on schedule.
- B. Complete packaged triplex assembly. Three motor-driven common base skidmounted oil-less compressors with UL listed triplex electrical control in a NEMA Type 12 control cabinet, AMSE receiver, aftercooler, refrigeration type air dryer and inline air intake filter/muffler. Assemble on heavy-duty fabricated steel subbase frame completely pre-wired and pre-piped to a single-point service connections including air dryer. Factory test prior to shipment.
- C. Cycling Refrigeration Air Dryer: Automatic drain trap and a three valve bypass system. Provide a pressure dew point of 35°F at 100 PSIG. Dryer will be mounted and piped on compressor skid and wired to the compressor control panel. A separate disconnect switch shall be furnished as standard on the dryer instrument panel.
- D. Receiver: Construct in accordance with appropriate ASME standards with National Board label affixed. Include pressure gage with dial graduated to double the operating pressure, pressure relief valve, gage glass, liquid sensing switch and automatic drain trap. Tank shall be galvanized steel.
- E. Motors: Standard open frame, drip-proof, ball bearing, 40°C rise, NEMA standard Design B induction type. Voltage as listed and required.
- F. UL Listed Triplex Electrical Control System: Mount in NEMA Type 12 cabinet. Include panel main disconnect switch, fusible disconnect switches, magnetic starters, hand-off-automatic (H-O-A) selector switches. 115-volt control transformers, timed unloader controls and automatic lead pump alternator. The external display shall include indicator lights to show each compressor “on” warning lights with horn and reset buttons to show thermal overload. All compressors over 5 HP shall be equipped with a run time meter. Trouble alarm dry contacts connection to BMS.
- G. Factory-trained service representative to review per manufacturer's recommendations, the assembly prior to initial start-up and operation instructions
- H. Provide all necessary inter-connections between compressors, controls and sensors.
- I. Provide high/low pressure switch for connection to BMS.

2.9 VACUUM PUMPS VP-1

- A. Sizes, type and capacity as scheduled on drawings.

- B. Complete factory-assembled packaged expandable vacuum system mounted on a common skid. Two motor-driven pump units with ASME code receiver and UL listed automatic alternating control system in a NEMA 12 control cabinet. Assembly is pre-piped and pre-wired to a single-point service connections. Factory test prior to shipment.
- C. Each pump shall be equipped with an automatic purge system to flush any gases from the pump to prevent condensation as the pump cools. Purge system shall include isolation valve and actuator, solenoid bleed valve, and controls to operate a 15-minute shutdown purge. If the supply of air or power is discontinued, the isolation valve will go to the closed position and the purge valve will go to the open position. The lead pump shall be time alternated and shall operate on a pressure-activated basis. Each pump shall be supplied with the initial charge of oil. Each pump shall be supplied with a threaded exhaust adapter to permit piping of the exhaust gases to a remote point.
- D. Pump Assembly: Two rotary vane, continuous duty, oil sealed, air cooled vacuum pumps, each with two needle bearings, two shaft seals and two fans to ensure cool operation. Pumps shall be skid mounted in a vertical arrangement which allows for future expansion to a triplex system.
- E. Appurtenances: Provide for each vacuum pump, check valves, isolation valves, oil filter and bypass, conical inlet screen, inlet particulate filter and vacuum gage.
- F. 200 gal. Receiver: Construct in accordance with ASME standards with National Board Label affixed and in steel construction. Furnish with gage glass assembly and drain valve.
- G. Motors: Totally enclosed, fan cooled motors, ball-bearing. 40°C rise, NEMA standard Design B, induction type. Voltage as listed and required.
- H. UL Listed Duplex Electrical Control System: Mount in NEMA 12 cabinet. Include panel main disconnect switch, fusible disconnect switches, magnetic motor starters with overload relays and reset switches, 110-volt control circuit transformers, vacuum control switches, can timer for automatically switching the operating sequence of the pumps, hand-off automatic selector switches and running lights. The entire control system shall be configured for future expansion to an automatic alternating triplex and a quadruplex unit. Trouble alarm dry contacts for connection to BMS.
- I. Include a factory-trained service representative to review, per manufacturer's recommendations, assembly prior to its initial start-up and operation instruction.
- J. Provide pressure switch for connection to BMS.

PART 3 –EXECUTION

3.1 PREPARATION

- A. Requirements for high purity compressed air systems.
 - 1. Pre-Installation Cleaning: Disassemble positive pressure gas systems pipe, fittings, valves, and components, except those supplied cleaned and prepared for intended service, and thoroughly wash in hot solution of sodium carbonate or trisodium phosphate mixed 1 lb to 3 gal of water. After washing, rinse with water, dry and cap until installation.

3.2 INSTALLATION

- A. Install line size isolation valve and check valve on compressor discharge.
- B. Place shut off valve on water inlet to Aftercooler. Pipe drain to floor drain.
- C. Connect condensate drains to nearest floor drain.
- D. Install drip connections with valves at low points of piping system.
- E. Install take-off to outlets from top of main, with shut off valve after take off. Slope takeoff piping to outlets.
- F. Install compressed air couplings, female quick connectors, and pressure gages where outlets are indicated.
- G. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
- H. Identify piping system and components.
- I. Braze joints in pipe and tubing. Avoid leaving excess flux inside of pipe and fittings. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
- J. Effect changes in size with reducing fittings. Make changes in direction of required turns or offsets with fittings or tubing shaped by bending tools. Make bends free of flattening, buckling or thinning of tube wall.
- K. Cut pipe and tubing accurately and install without springing or forcing.
- L. Install pipe level or grade piping down in direction of flow.

- M. Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions.
- N. Finish flush at both ends. Extend 2 inches above finished floors. Pack space between pipe or tubing and sleeve, and caulk.
- O. Identify piping with tape and decals. Provide piping identification code and schematic. Install labeling on pipe at intervals of not more than 20 feet and at least once in each room and each story traversed by pipeline.
- P. Coordinate provision of utility warning and identification tape with backfill operation. Provide above all buried lines at a depth of 8 to 12 inches below finish grade.
- Q. Install underground piping in trench minimum 42 inches deep adequately protected against physical damage and corrosion, or in ducts and tunnels, which are not occupied by fuel oil lines and are vented.
- R. Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.
- S. Install strainers on inlet side of main pressure reducing valves. Provide main gas valves (pressure reducing or flow control) with bypasses and isolation valves to permit maintenance without interruption of gas.
- T. Provide a by-pass with valves, around receivers.

3.3 FIELD QUALITY CONTROL

- A. Section 01450 - Quality Requirements: Testing and Inspection Services, 01770 - Execution Requirements: Testing, adjusting, and balancing.
- B. Test for Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ANSI B31.1.
- C. Independent testing agency to certify system is complete, zone valves installed, alarm systems functional, and tests performed. Document tests and submit.
- D. Ensure that there is atmospheric pressure in piping systems, other than the system under test.
- E. Test system with dry compressed air or dry nitrogen with test pressure in piping system at 3 times system operating pressure.

- F. Check each station outlet of every piping system to determine test gas is dispensed only from outlet of system under investigation. Measure pressure with gage attached to specific adapter. Do not use a universal adapter.
- G. Disconnect test gas and connect proper gas to each system. Purge entire system to remove test gas. Check with analyzer suitable for gas installed.

3.4 CLEANING

- A. Section 01770 – Closeout and Turnover Procedures: Final cleaning
- B. After erection of pipe and tubing but prior to installation of service outlet valves, blow systems clear of free moisture and foreign matter with nitrogen gas.
- C. Install service outlet valves, subject system to test pressure equal to 150% of operating pressure with nitrogen or dry compressed air. Check with soapy water. Provide 24-hour standing pressure test.

END OF SECTION