

SECTION 22 6005
MEDICAL AIR, GAS, AND VACUUM SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Medical oxygen gas system.
- B. Medical compressed air system.
- C. Medical vacuum system.
- D. Nitrous oxide system.
- E. Nitrogen system.

1.02 RELATED REQUIREMENTS

- A. Section _____: Prefabricated patient bedside units.
- B. Section _____: Product requirements for bottled medical gases for placement by this section.
- C. Section 07 8400 - Firestopping.
- D. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- E. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- F. Section 22 0719 - Plumbing Piping Insulation.
- G. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- C. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
- D. ASME BPVC - Boiler and Pressure Vessel Code; 2015.
- E. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- H. ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems; 2000 (Reapproved 2011).
- I. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- J. CGA G-7 - Compressed Air for Human Respiration; 2008.
- K. CGA V-5 - Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications); 2008.
- L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- M. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- N. MSS SP-88 - Diaphragm Valves; 2010.
- O. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- P. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- Q. NFPA 55 - Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks; 2013.
- R. NFPA 99 - Health Care Facilities Code; 2015.
- S. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
- C. Shop Drawings: Indicate general assembly of components, mounting and installation details, and general layout of control and alarm panels. Submit detailed medical wall assembly drawings.
- D. Samples: Submit two of each outlet.
- E. Certificates: Certify that products meet or exceed specified requirements.
- F. Independent Testing Agency Reports: Indicate systems are complete, zone valves installed, alarm systems functional, and pressure and cross connections tests performed. Document tests.
- G. Manufacturer's Instructions: Indicate installation requirements for equipment and systems.
- H. Manufacturer's Field Reports: Indicate systems are complete, zone valves installed, and alarm systems functional.
- I. Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
- J. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- L. Project Record Documents: Record actual locations of piping, valving, and outlets.
- M. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Valves: One of each type and size.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 99.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- D. Comply with applicable codes for medical gas systems.
- E. Provide certificate of compliance from authorities having jurisdiction, indicating approval of systems.
- F. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.06 MOCK-UP

- A. Provide mock-up of outlets in typical patient head wall unit.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept material on site in factory containers and packing. Inspect for damage.
- B. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Provide five year manufacturer warranty for _____.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Amico Corporation: www.amico.com.
B. BeaconMedaes: www.beaconmedaes.com.
C. Powerex, Inc; _____.www.powerexinc.com

2.02 PIPE AND FITTINGS

- A. Factory Preparation: Wash inside of copper pipe and copper fitting with hot solution of sodium carbonate or trisodium phosphate mixed 1 lb to 3 gal of water; rinse with water, and blow dry with oil-free dry nitrogen or compressed air.
- B. Oxygen, Compressed Air, Nitrous Oxide, Nitrogen Systems, Aboveground:
1. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn.
 2. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper.
 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- C. Vacuum and Anesthesia Gas Evacuation Systems, Aboveground:
1. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn.
 2. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper.
 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 silver braze or ASTM B32, solder, Grade Sn95.

2.03 VALVES

- A. Factory Preparation for Oxygen Service: Disassemble, clean, degrease, seal, and pack for shipping.
- B. Ball Valves:
1. Requirements: Comply with MSS SP-110; bronze body, three piece, double-seal ball valves with replaceable neoprene or teflon seat and stem seals, for minimum 600 psi cold working pressure, flange or union mounting, labeled for intended service.
- C. Diaphragm Valves (Oxygen, Nitrous Oxide and Nitrogen):
1. MSS SP-88, brass-bodied, packless, diaphragm type with regrinding or renewable seats and disks, for minimum 300 psi working pressure.
- D. Pressure Regulation Valves (Medical Air):
- E. Gate Valves (Vacuum, Medical Air, and Anesthesia Gas Evacuation System):
1. MSS SP-80; Class 150 bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

2.04 PIPING ACCESSORIES

- A. Hangers and Supports: MSS SP-58 with types as required.
- B. Pressure Gages:
1. ASME B40.100, white dials and black lettering with restrictor.
 2. Oxygen and nitrous oxide systems: Manufactured and labeled expressly for intended service; UL labeled.
- C. Vacuum Bottle Brackets: Stainless steel, chrome-plated metal, or aluminum with finish matching adjacent outlet.
- D. Flexible Connectors: Corrugated flexible, single ply, seamless or seam-welded tubing of stainless steel or bronze or reinforced teflon bellows or hose.
- E. Valve Cabinets:
1. Extruded aluminum, flush-mounted and rigidly assembled to accommodate valves and fittings, punched or drilled sides to receive tubing, anchors to secure to wall construction.
 2. Cover Plates: Extruded aluminum, with replaceable plastic windows with pull ring to remove window.

3. Cabinet Labels: labeled and color coded for intended service and area served.
 4. Valves: Pre-assemble and mount chrome plated valves and tubing extensions.
 5. Gages: Provide where indicated and in operating rooms areas downstream of isolating valves.
- F. Piping Identification: Pressure sensitive adhesive tape and decals, color and labeling to conform with Section 22 0553.

2.05 OUTLETS

- A. Outlet Units:
1. Manufacturers:
 - a. Amico Corporation; _____: www.amico.com.
 - b. BeaconMedaes; _____: www.beaconmedaes.com.
 2. CGA V-5, Diameter-Index Safety System (DISS) non-interchangeable connectors, automatic valves, secondary check valves (except vacuum and evacuation outlets), and capped 3/8 inch 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 faceplate with Lexan cover, color coded with embossed labeling.

2.06 NITROUS OXIDE MANIFOLD

- A. Manufacturers:
1. Amico Corporation; _____: www.amico.com.
 2. BeaconMedaes; _____: www.beaconmedaes.com.
- B. Manifold Delivery: Maximum 220 cfh nitrous oxide continuously at 50 psi. Provide automatic changeover from primary to secondary bank and allow replacing depleted cylinders with no change in line pressure.
- C. By-Pass System: Between regulators to service regulator or switch over system without interrupting supply of gas. Bleed valves piped to vent connector within cabinet shall allow adjustment of pressure reducing regulators.
- D. Cabinet: House components in lockable cabinet with baked enamel finish.
1. Three front mounted gages indicate bank and hospital line pressures.
 2. Green indicator light indicates service bank in use.
 3. Red indicator light indicates reserve bank in use.
 4. Provide terminal block connections for remote alarms.

2.07 NITROGEN MANIFOLD

- A. Manufacturers:
1. Amico Corporation; _____: www.amico.com.
 2. BeaconMedaes; _____: www.beaconmedaes.com.
- B. Duplex Nitrogen Manifold: Consist of wall mounted control cabinet and necessary header connection and pigtails for ____ cylinders. Arrange controls to have half of cylinders in service and half in reserve.
- C. Manifold Delivery: Maximum 220 cfh nitrogen continuously at 180 psi. Provide automatic changeover from primary to secondary bank and allow replacing depleted cylinders with no change in line pressure. Provide bank regulators to reduce cylinder pressure for line regulator set at 160 psi delivery pressure. Provide manifold relief valve set at 240 psi.
- D. By-Pass System: Between regulators to service regulator or switch over system without interrupting supply of gas. Bleed valves allow adjustment of pressure reducing regulators.
- E. Cabinet: House components in lockable cabinet with baked enamel finish.
1. Three front mounted gages indicate bank and hospital line pressures.

2. Green indicator light indicates service bank in use.
3. Red indicator light indicates reserve bank in use.
4. Provide terminal block connections for remote alarm.

2.08 MEDICAL COMPRESSED AIR SYSTEM

- A. Manufacturers:
1. Amico Corporation; _____: www.amico.com.
 2. BeaconMedaes; _____: www.beaconmedaes.com.
- B. Duplex Air Compressor System:
1. To deliver CGA G-7 compressed air.
 2. Rotary Oil Free Liquid Ring Compressors: Equipped with check valve, inlet and outlet flexible connector, isolation valve, safety relief valve, air by-pass solenoid valve, water air separator, float trap, strainer, compound gage, solenoid valve, bypass solenoid valve and metering valve for service liquid, inlet mufflers, motor coupling with guard.
 3. Capacity: _____ cfm at _____ psi.
 4. Electrical Characteristics:
 - a. _____ hp.
 - b. _____ volts, single phase, 60 Hz.
- C. Refrigerated Air Dryer: Non-cycling hermetic type with capacity of _____ cfm capable of drying 100 psi at 100 degrees F saturated air to 35 degrees F dew point at 100 degrees F ambient, with automatic drain trap, three valve by-pass system, _____ hp motor and safety disconnect switch in NEMA 250 Type 1 general purpose enclosure, wired from compressor controller.
- D. Duplex Controller: Pre-wired in NEMA 250 Type 12 enclosure with fusible disconnects, magnetic motor starters with overload protection, control circuit transformers, clock timer, automatic water and air by-pass circuits, pressure switches, hand-off automatic selector switches mounted in cabinet cover, and safety disconnect door.
- E. Receiver: _____ gallon vertical welded steel ASME receiver, prime coated with vinyl lining, with gage, safety relief valve, and automatic tank drain.
- F. Air Line Filter Regulator: Regulating assembly with line pressure adjusting knob, 2 inch diameter line pressure gage, 1-1/4 inch pipe size connections, clear polycarbonate collection bowl with 5 micron filter unit and automatic drain.

2.09 MEDICAL VACUUM SYSTEM

- A. Manufacturers:
1. Amico Corporation; _____: www.amico.com.
 2. BeaconMedaes; _____: www.beaconmedaes.com.
- B. Duplex Vacuum Pump:
1. Rotary Liquid Ring Pumps: Tank mounted, each equipped with check valve, inlet flexible connector, water separator, strainer, compound gage, solenoid valve and metering valve for service liquid, exhaust muffler, motor coupling with guard.
 2. Capacity: _____ cfm expanded air at _____ psi, capable of producing maximum vacuum of _____ inches hg.
 3. Electrical Characteristics:
 - a. _____ hp.
 - b. _____ volts, single phase, 60 Hz.
- C. Electrical Controls: Pre-wired in NEMA 250 Type 12 enclosure, with fusible disconnects, magnetic motor starters, overload protection with manual reset, control circuit transformers, automatic alternators, vacuum control switches, hand-off automatic switches in cabinet cover, and safety disconnect door.
- D. Receiver: _____ gallon vertical welded steel ASME receiver, prime coated with vinyl lining, with gage, safety relief valve, and automatic tank drain.

2.10 ANESTHESIA GAS EVACUATION PUMPS

- A. Manufacturers:

1. Allied Healthcare Products, Inc; _____: www.alliedhpi.com.
 2. BeaconMedaes; _____: www.beaconmedaes.com.
 3. Busch, Inc; _____: www.buschpump.com.
- B. Conform with Medical Vacuum System.
1. Exception: Pumps suitable for handling flammable gases.
 2. Capacity: _____ cfm, capable of producing vacuum of _____ inches hg.
 3. Electrical Characteristics:
 - a. _____ hp.
 - b. _____ volts, single phase, 60 Hz.
- C. Receiver: _____ gallon vertical welded steel ASME receiver, prime coated with vinyl lining, with gage, safety relief valve, and automatic tank drain.

2.11 OXYGEN MANIFOLD

- A. Manufacturers:
1. Amico Corporation; _____: www.amico.com.
 2. BeaconMedaes; _____: www.beaconmedaes.com.
- B. Duplex Automatic Manifold: Consisting of wall mounted control cabinet and necessary header connections and pigtailed for _____ cylinders, arranged for _____ cylinders in service and _____ cylinders in reserve.
- C. Delivery: Maximum 220 cfm oxygen continuously at 50 psi. Provide automatic changeover from primary to secondary bank and allow replacing depleted cylinders with no change in line pressure.
- D. By-Pass System: Locate between regulators to service regulator or switch over system without interrupting supply of gas. Pipe bleed valves to vent connector within cabinet to allow adjustment of pressure reducing regulators.
- E. Cabinet: House components in lockable cabinet with baked enamel finish.
1. Three front mounted gages: Indicate bank and hospital line pressures.
 2. Green indicator light: Indicate service bank in use.
 3. Red indicator light: Indicate reserve bank in use.
 4. Terminal block: Connections for remote alarms.

2.12 ALARM SYSTEM

- A. High-Low Pressure Alarm Panels: Closed circuit, self-monitoring type, to monitor oxygen, vacuum, compressed air, nitrous oxide, and nitrogen.
1. Green light for systems normal.
 2. High or low pressure warning:
 - a. Green light extinguishes.
 - b. Audible warning device sounds.
 - c. Red light energizes.
 3. Gage indicates pressure or vacuum.
 4. Switch silences warning device.
 5. Test switch to test light bulbs and audible warning device.
 6. Provide system with internal switches, gages, control unit, and transformer.
- B. Multi-Signal Alarm Panel:
1. Closed circuit, self-monitoring type, to monitor oxygen, vacuum, compressed air, nitrous oxide, and nitrogen piping systems pressure or liquid level.
 2. Green light for systems normal.
 3. For abnormal condition:
 - a. Green light extinguishes.
 - b. Audible warning device sounds.
 - c. Red light energizes.
 4. Switch silences warning device.
 5. Test switch to test light bulbs and audible warning device.

6. Design system such that one, two or more monitors may be connected to a single pressure switch.
7. Monitor following abnormal conditions:
 - a. Oxygen reserve supply in use.
 - b. Oxygen line pressure high.
 - c. Oxygen line pressure low.
 - d. Air line pressure high.
 - e. Air line pressure low.
 - f. Air lag pump on.
 - g. Vacuum line pressure above normal.
 - h. Vacuum line pressure below normal.
 - i. Vacuum lag pump on
 - j. Nitrous oxide reserve supply in use.
 - k. Nitrous line pressure high.
 - l. Nitrous line pressure low.
 - m. Nitrogen reserve supply in use.
 - n. Nitrogen line pressure high.
 - o. Nitrogen line pressure low.
8. High-Low Pressure Switch: Dual circuit with two single pole, double throw, snap action switches, tested at 180 psi with adjustable range of 4 psi, preset at 40 psi and 60 psi.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with NFPA 99.
- B. 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.
- C. 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.
- D. 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.
- E. Cut pipe and tubing accurately and install without springing or forcing.
- F. Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Finish flush at both ends. Extend 2 inches above finished floors. Pack space between pipe or tubing and sleeve, and calk.
- G. Identify piping with tape and decals. Provide piping identification code and schematic for installation under provisions of Section 22 0553. 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.
- H. Support gas piping with pipe hooks or hangers suitable for size of pipe, spaced:
 1. 1/2 inch pipe or tubing: 72 inches.
 2. 3/4 inch or one inch pipe or tubing: 96 inches.
 3. 1-1/4 inches or larger (horizontal): 120 inches.
 4. 1-1/4 inches or larger (vertical): Every floor level.
- I. Install strainers on inlet side of pressure reducing valves. Provide main gas valves (pressure reducing or flow control) with by-passes and isolation valves to permit maintenance without interruption of gas.
- J. Provide a valved by-pass around receivers.
- K. Medical Air Compressor Systems: Isolate systems including receivers, dryers, and filters until after completion and approval of purity tests for compressed air system. Tie-in at flange or union joint.

3.02 PIPING SYSTEMS CLEANING AND PRESSURE TESTING

- A. 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.
- B. Install service outlet valves, subject system to test pressure of 150 psi with nitrogen or dry compressed air. Check with soapy water. Provide 24-hour standing pressure test.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Independent testing agency to certify system is complete, zone valves installed, alarm systems functional, and tests performed. Document tests and submit.

END OF SECTION