

SECTION 22 63 00
GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Healthcare Gas Systems: Consisting of oxygen and medical air services; complete, ready for operation, including all necessary piping, fittings, valves, station outlets, rough-ins, gages, alarm, including low voltage wiring and all necessary parts. Verify station outlet terminal connections with Facility. BeaconMedaes is the equipment manufacturer requested by the Facility.
- B. Healthcare gas system alarm wiring from piping to alarm panel.

1.2 RELATED WORK

- A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. Sealing around pipe penetrations through the floor to prevent moisture migration: Section 07 92 00, JOINT SEALANTS.
- C. General requirements and items common to more than one section of Division 22. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Alarm interface with ECC. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- E. Vacuum Piping and Equipment: SECTION 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

1.3 QUALITY ASSURANCE

- A. Materials and Installation: In accordance with NFPA 99, (2005) and as specified.
- B. Equipment Installer: Show technical qualifications and previous experience in installing healthcare equipment on three similar projects. Submit names and addresses of referenced projects. Installers shall meet the qualifications of ANSI/ASSE Standard 6010.
- C. Equipment Supplier: Show evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years. Submit names and addresses where the product is installed.
- D. Healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of healthcare pipeline testing. Testing and systems verification shall be performed by personnel meeting the qualifications of ANSI/ASSE Standard 6030. Such testing shall be performed by a party other than the installing contractor.

- E. Provide names of three projects where testing of medical gases systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.
- F. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.
- G. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- H. Installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided on prints and in digital format. The digital format shall be in the native CAD system required for the project design. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- I. "Hot taps" are not permitted for operating medical oxygen systems. Methods for connection and extension of active and pressurized medical gas systems without subsequent medical gas testing and verification are not allowed.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. Valves.
 - 3. Valve cabinets.
 - 4. Gages.
 - 5. Station outlets and rough-in assemblies.
 - 6. Alarm panel.

7. Pressure Switches.

- C. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.
- D. Certification: The completed systems have been installed, tested, purged, analyzed and verified in accordance with the requirements of this specification.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
B819-(R2006).....Seamless Copper Tube for Medical Gas Systems
- C. American Society of Mechanical Engineers (ASME):
A13.1-07.....Scheme for Identification of Piping Systems
B16.22-01(R2005).....Wrought Copper and Bronze Solder-Joint Pressure Fittings
B40.100 (2005)Pressure Gauges and Gauge Attachments Boiler and Pressure Vessel Code -
Section IX-07.....Welding and Brazing Qualifications
- D. American Welding Society (AWS):
AWS A5.8-04.....Brazing Filler Metal
AWS B2.2-91.....Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)
- E. National Fire Protection Association (NFPA):
99-05.....Health Care Facilities
- F. Manufacturing Standardization Society (MSS):
MSS-SP-73-03.....Brazing Joints for Copper and Copper Alloy Solder Pressure Fittings

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Copper Tubing: Type "K", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting

nominal inside diameter. All tubing and fittings shall be labeled "OXY", "OXY/MED", or "MED".

- B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.
- C. Screw Joints: Polytetrafluoroethylene (teflon) tape.
- D. Memory metal couplings: Temperature and pressure rating shall not be less than that of a brazed joint.
- E. Apply piping identification labels at the time of installation in accordance with current NFPA. Apply supplementary color identification in accordance with CGA Pamphlet C-9.
- F. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:
 - 1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
 - 2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
 - 3. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.2 VALVES

- A. Ball: In-line, other than zone valves in cabinets:
 - 1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full port, three-piece or double union end connections, teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service
- B. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure service to 100 kPa (29 inch Hg), cleaned for oxygen use and labeled for intended service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, and pressure tested. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one

manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN
MEDICAL AIR	Black or white letters on yellow background	YELLOW

2.3 VALVE CABINETS: ZV1

- A. Flush mounted commercially available item for use with healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be dust tight. Locate bottom of cabinet 1375 mm (4 foot 6 inches) above floor.
- B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."
- C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: CAUTION-CLOSE ONLY IN EMERGENCY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.
- D. Cabinets and isolation valves shall be located and piped as shown, so as to allow the isolation of each smoke compartment.
- E. Valving: 1 1/4" vacuum, 1/2" oxygen, 3/4" medical air.

2.4 STATION OUTLETS

- A. For designated service, consisting of a quick coupler and inlet supply tube. Provide coupler that is non-interchangeable with other services,

and leak proof under three times the normal working pressure. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet securely to rough-in to prevent floating and provide each with a capped stub length of 1/2-inch outside diameter tubing for connection to supply. Identification of each gas service shall be permanently cast into the back plate and shall be visible through a transparent plastic guard. Label stub tubing for appropriate service.

B. Station Grouping:

1. **MG1** - air, oxygen, oxygen, blank, vacuum, blank, slide bracket, blank, vacuum, blank, slide bracket.
2. **MG1A** - air, oxygen, oxygen, blank, vacuum, blank, slide bracket, blank, vacuum, blank, slide bracket. Furnish with stainless steel housing with frame, door with piano hinge, cylinder lock and key.
3. **MG2** - air, oxygen, oxygen, blank, vacuum, blank, slide bracket, blank, vacuum, blank, slide bracket, blank, vacuum, blank, slide bracket.
4. **MG3** - oxygen, blank, vacuum, blank, slide bracket.

2.5 STATION OUTLET ROUGH-IN

- A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.
- B. Modular Cover Plate: Die cast back plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, with mounting flanges on all four sides, secured to rough-in with stainless steel or chromium plated countersunk screws.
- C. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background
MEDICAL AIR	Black or white letters on yellow

2.6 ALARM: AL1

- A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system, in conformance with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- B. Area Alarm Functions:
 - 1. Oxygen and medical air alarm: Pressure alarms function when pressure in branch drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi) or increases above 414 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
 - 2. Vacuum alarms: Low vacuum alarm functions when vacuum in branch drops below 40 kPa (12-inches Hg); operated by vacuum switch.
- C. Alarm Panel:
 - 1. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete system. Alarm panel shall be integral unit, reporting oxygen, medical air and vacuum services as required.
 - 2. Box: Flush mounted, sectional or one piece, corrosion protected. Size to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely. Provide spare capacity to accommodate 50% of the number of provided alarm points.
 - 3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.
 - 4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.
 - 5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.
 - 6. Controls:
 - a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular

service shall give a lighted visual signal which cannot be canceled until such condition is corrected.

- b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.
- c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.
- D. Alarm Relay Interface Control: Alarm panel to have capability to transfer the closed circuit alarm signals through relays to a set of terminals for monitoring signals at the ECC without interrupting the closed circuit system. Provide both normally open and normally closed contacts for output signals, with number of circuits required for full alarm capability at the ECC. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for compatibility.

2.7 PRESSURE SWITCHES

- A. General purpose, contact or mercury type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range set by inside or outside adjustment; switches activate when indicated by alarm requirements. Use one DISS demand check valve for each sensor or pressure switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. In accordance with current NFPA.
- B. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.
- C. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.
- D. Spacing of hangers: Current NFPA.

- E. While being brazed, joints shall be continuously purged with oil free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.
- F. Do not bend tubing. Use fittings.
- G. Install pressure switches and gauges to be easily accessed. Install pressure switch and sensors with demand check valve between the pipe line and switches/sensors.
- H. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- I. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.
- J. Penetrations:
 - 1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.
 - 2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- K. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.
- L. Provide zone valves in cabinets where indicated.

3.2 TESTS

- A. Installer Performed Tests:
 - 1. General.
 - a. The tests required by NFPA 99 5.1.12.2 shall be performed and documented by the installer prior to the tests required for System Verification.
 - b. The test gas shall be oil-free, dry Nitrogen NF.
 - c. Where manufactured assemblies are to be installed, the tests required by 5.1.12.2 shall be performed as follows:
 - 1. After completion of the distribution piping but before the standing pressure test.
 - 2. Prior to installation of manufactured assemblies supplied through flexible hose or flexible tubing.
 - 3. At all station outlets/inlets on installed manufactured assemblies supplied through copper tubing.

2. Initial Blow Down. Piping in medical gas and vacuum distribution systems shall be blown clear by means of oil-free, dry Nitrogen NF as follows:
 - a. After installation of the distribution piping.
 - b. Before installation of station outlets/inlets and other system components (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, pressure relief valves, manifolds, source equipment).
3. Initial Pressure Test.
 - a. Each section of the piping in medical gas and vacuum systems shall be pressure tested.
 - b. Initial pressure tests shall be conducted as follows:
 1. After installation of station outlets/inlets rough-in assemblies. Test caps shall be permitted to be used.
 2. Prior to the installation of components of the distribution piping system that would be damaged by the test pressure (e.g., pressure/vacuum alarm devices, pressure/vacuum indicators, line pressure relief valves, manufactured assemblies with flexible hose, hose, etc.)
 - c. The source shutoff valve shall remain closed during these tests.
 - d. The test pressure for pressure gasses shall be 1.5 times the system working pressure but not less than a gauge pressure of 1035 kPa (150 psi).
 - e. The test pressure for vacuum shall be not less than a gauge pressure of 415 kPa (60 psi).
 - f. The test pressure shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection that is safe for use with oxygen.
 - g. Leaks, if any, shall be located, repaired (if permitted), replaced (if required), and retested.
4. Cross-Connection Test. It shall be determined that no cross-connections exist between the various medical gas and vacuum piping systems.
 - a. All piping systems shall be reduced to atmospheric pressure.
 - b. Sources of test gas shall be disconnected from all piping systems except for the one system being tested.
 - c. The system under test shall be charged with oil-free, dry Nitrogen NF to a gauge pressure of 345 kPa (50 psi).
 - d. After the installation of the individual faceplates with appropriate adapters matching outlet/inlet labels, each individual

outlet/inlet in each installed medical gas and vacuum piping system shall be checked to determine that the test gas is being dispensed only from the piping system being tested.

- e. The cross-connection test shall be repeated for each installed medical gas and vacuum piping system.
 - f. The proper labeling and identification of system outlets/inlets shall be confirmed during these tests.
5. Piping Purge Test. The outlets in each medical gas piping system shall be purged to remove any particulate matter from the distribution piping.
- a. Using appropriate adapters, each outlet shall be purged with an intermittent high-volume flow of test gas until the purge produces no discoloration in a clean white cloth.
 - b. This purging shall be started at the closest outlet/inlet to the zone valve and continue to the furthest outlet/inlet within the zone.

6. Standing Pressure Test for Positive Pressure Medical Gas Piping.

After successful completion of the initial pressure tests, medical gas distribution piping shall be subject to a standing pressure test.

- a. Tests shall be conducted after the final installation of station outlet valve bodies, faceplates, and other distribution system components (e.g., pressure alarm devices, pressure indicators, line pressure relief valves, manufactured assemblies, hose, etc.).
- b. The source valve shall be closed during this test.
- c. The piping systems shall be subjected to a 24-hour standing pressure test using oil-free, dry Nitrogen NF.
- d. Test pressures shall be 20 percent above the normal system operating line pressure.
- e. At the conclusion of the tests, there shall be no change in the test pressure other than that attributed to changes of ambient temperature.
- f. Leaks, if any, shall be located, repaired (if permitted) or replaced (if required), and retested.

B. Healthcare Gas System Testing organization shall perform the following:

- 1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.

2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
4. Piping purity test: For each positive pressure system, verify purity of piping system.
5. Outlet and inlet flow test:
 - a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
 - b. Oxygen and medical air outlets must deliver 100 Lpm (3.5 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 350 kPa (50 psi).

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