SECTION 22 63 00
GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Central Laboratory and Healthcare Gas Systems: Consisting of laboratory air services; complete, ready for operation, including all necessary piping, fittings, valves, station outlets, rough-ins, gages, and all necessary parts, accessories, connections and equipment. Match existing station outlet and inlet terminal connections.

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. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

Requirements for commissioning, systems readiness checklist, and training.

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 laboratory and 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. Laboratory and healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of laboratory and 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 or laboratory 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 phases 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.

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. Inlet and outlet cocks

4. Gages.

5. Station outlets and rough-in assemblies.

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.

E. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

1.5 TRAINING

A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the laboratory and healthcare gas systems, on the dates requested by COTR.

B. Coordinate with other requirements specified in Section 01 00 00, GENERAL REQUIREMENTS.

1.6 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 VIII-07 .....Pressure Vessels, Division I

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. Compressed Gas Association (CGA):

C-9-04 .....Standard Color Marking of Compressed Gas Cylinders

G-4.1 (2009) .....Cleaning Equipment for Oxygen Service

G-10.1(2008) .....Nitrogen, Commodity

P-9-01 .....Inert Gases Argon, Nitrogen and Helium

V-1-05 .....Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections

F. National Electrical Manufacturers Association (NEMA):

ICS-6-93(R2006) .....Industrial Controls and Systems Enclosures

G. National Fire Protection Association (NFPA):

99-05 .....Health Care Facilities

H. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)

I. Manufacturing Standardization Society (MSS):

MSS-SP-72-99 .....Ball Valves With Flanged or Butt Welding For General Purpose

MSS-SP-110-96 .....Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

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 "ACR/OXY", "OXY", "OXY/MED", "ACR/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. 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.

2.2 EXPOSED LABORATORY AND HEALTHCARE GASES PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed laboratory and healthcare gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight.

2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish, (125 and 250 PS1 Classes).

3. Nipples: ASTM B 687, Chromium-plated.

4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

2.3 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

2.4 GAGES

A. Pressure Gages: Includes gages temporarily supplied for testing purposes.

1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for compressed air, nitrogen and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.

2. For all services downstream of main shutoff valve: Manufactured for oxygen use, labeled for the appropriate service and marked "USE NO OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1-690 kPa (1-100 psi) for air service, and 1-690 kPa (1-100 psi) 1-2050 kPa (1-300 psi)for [insert special gas here] service.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

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. Rigidly support valves and other equipment to prevent strain on tube or joints.

F. 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.

G. Do not bend tubing. Use fittings.

H. Support ceiling column assembly from heavy sub-mounting castings furnished with the unit as part of roughing-in. Anchor with 15 mm (1/2-inch) diameter bolts attached to angle iron frame supported from structural ceiling, unless otherwise indicated.

I. Provide two 25 mm (1 inch) minimum conduits from ceiling column assembly to adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, for connection to signal cabling network.

J. Install pressure switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.

K. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.

L. Pipe compressor intake to a source of clean ambient air as indicated in current NFPA.

M. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.

N. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked 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.

O. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.

3.2 TESTS

A. Initial Tests: Blow down, and high and low pressure leakage tests as required by current NFPA with documentation.

B. Laboratory and healthcare testing agency 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. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Perform test with the use of an inert gas as described in CGA P-9.

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, nitrous oxide and 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).

   c. Nitrogen outlets must deliver 565 Lpm (20 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 1445 kPa (210 psi).

   d. Needle valve air outlets must deliver 1.5 scfm with a pressure drop of no more than five psi, and static pressure of 350 kPa (50 psi).

6. Source Contamination Test: Analyze each pressure gas source for concentration of contaminants, by volume. Take samples for air system test at the intake and at a point immediately downstream of the final filter outlet. The compared tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Allowable concentrations are below the following:

Dew point, air	4 degrees C (39 degrees F) pressure dew point at 690 kPa (100 psi)
Carbon monoxide, air	10 mg/L (ppm)
Carbon dioxide, air	500 mg/L (ppm)
Gaseous hydrocarbons as methane, air	25 mg/L (ppm)
Halogenated hydrocarbons, air	2 mg/L (ppm)

7. Analysis Test:

   a. Analyze each pressure gas source and outlet for concentration of gas, by volume.

   b. Make analysis with instruments designed to measure the specific gas dispensed.

   c. Allowable concentrations are within the following:

      1) Laboratory air 19.5 percent to 23.5 percent oxygen.

Oxygen	>=97 plus percent oxygen
Nitrous oxide	>=99 plus percent nitrous oxide
Nitrogen	>=99 plus percent nitrogen

Medical air	19.5 percent to 23.5 percent oxygen
Carbon Dioxide	99 plus percent carbon dioxide

2) [add name of special gas and analysis test criteria here].

8. Maximum Allowable Variation: Between comparative test results required are as follows:

Dew point	2 degrees C (36 degrees F)
Carbon monoxide	2 mg/L (ppm)
Total hydrocarbons as methane	1 mg/L (ppm)
Halogenated hydrocarbons	2 mg/L (ppm)

C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.3 CONNECTION TO EXISTING LABORATORY GAS SYSTEM:

A. Contactor shall test the existing system for hydrocarbons, dew point, etc. If problems are present, the resident engineer (RE) would notify the facility of the results. The facility would then make the necessary repairs and/ or maintenance.

B. Install shut-off valve at the connection of new line to existing line.

C. Coordinate time for shut-down of the existing laboratory and healthcare system with the VA medical center.

D. Shut off all oxygen zone valves and gas riser valves if the section to be connected to cannot be totally isolated from the remainder of the system.

E. Prior to any work being done, check the new pipeline for particulate or other forms of contamination.

F. Insure that the correct type of pipe tubing and fittings are being used.

G. Make a spot check of the existing pipelines in the facility to determine the level of cleanness present.

H. Reduce the pressure to zero and make the tie-in as quickly as possible. A nitrogen purge is not required since this would require another opening in the pipe.

I. After the tie-in is made and allowed to cool, slowly bleed the source gas back into the pipeline. Test the work area for leaks with soapy water and repair any leaks.

J. After all leaks, if any, are repaired and the line is fully recharged, perform blow down and testing. Open the zone that is closest to the main to the system, access the closest outlet to the work, and blow the main through the outlet. After the outlet blows clear into a white cloth, make an additional check at a zone most distant from the work. Perform all required current NFPA tests after connection.

3.4 COMMISSIONING

A. Provide commissioning documentation accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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