SECTION 226313 - GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Carbon dioxide piping, designated **["medical carbon dioxide"] [and] ["laboratory carbon dioxide"]**.

Helium piping, designated **["medical helium"] [and] ["laboratory helium**"].

Nitrogen piping, designated **["medical nitrogen"] [and] ["laboratory nitrogen**"].

Nitrous oxide piping, designated **["medical nitrous oxide"] [and] ["laboratory nitrous oxide"]**.

Oxygen piping, designated **["medical oxygen"] [and] ["laboratory oxygen"].**

Retain first subparagraph below to specify laboratory specialty gases and revise Section Text throughout.

<**Insert specialty gas**> piping, designated "specialty <**Insert designation**>."

Ball valves.

Check valves.

Emergency oxygen connections.

Gas safety valves.

Gas-service connections.

Patient-service consoles.

Nitrogen-pressure-control cabinets.

Ceiling columns.

Gas manifolds.

Simplex specialty gas manifolds.

Duplex specialty gas manifolds.

Bulk gas storage tanks.

Gas cylinder storage racks.

Retain "Director’s Representative-Furnished Material" paragraph below if Director’s Representative furnishes own material for installation in completed Work.

* + - * 1. Director’s Representative-Furnished Material:

If Work items are listed in subparagraphs below, delete their descriptions from Part 2 and from the "Section Includes" paragraph above, but retain installation and connection requirements in Part 3.

Patient-service consoles.

Ceiling columns.

Gas manifolds.

Bulk medical gas storage tanks.

<**Insert product**>.

Retain subparagraph below if Director’s Representative furnishes test gases.

Director’s Representative will furnish gases for [**medical**] [**laboratory**] gas concentration testing specified in this Section.

* + - * 1. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 115313 "Laboratory Fume Hoods" for gas outlets in laboratory fume hoods.

Section 123553.13 "Metal Laboratory Casework" for gas outlets in laboratory fume hoods.

Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework" for gas outlets in plastic-laminate-clad laboratory casework.

Section 123553.19 "Wood Laboratory Casework" for gas outlets in laboratory casework.

Section 123570 "Healthcare Casework" for gas outlets in medical casework.

Section 226400 "Medical Gas Alarms" for combined medical air, vacuum, and gas alarms.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. CR: Chlorosulfonated polyethylene synthetic rubber.

Gases in first paragraph below are defined as medical gases in NFPA 99.

* + - * 1. Medical gas piping systems include medical carbon dioxide, medical helium, medical nitrogen, medical nitrous oxide, and medical oxygen <**Insert other medical and combination gases**> for healthcare facility patient care.

Gases in paragraph below are defined as laboratory gases in NFPA 55.

* + - * 1. Laboratory gas piping systems include carbon dioxide, helium, nitrogen, nitrous oxide, and oxygen <**Insert other medical and combination gases**> for laboratories.
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.
				5. Shop Drawings: Include diagrams for power, signal, and control wiring.
				6. Qualification Data: For [**Installer**] [**and**] [**testing agency**].

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates, for [**gas manifolds**] [**and**] [**bulk gas storage tanks**], from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Material Certificates" paragraph below if Project includes medical gas systems for healthcare facilities.

* + - * 1. Material Certificates: Signed by Installer, certifying that medical gas piping materials comply with requirements in NFPA 99 “Health Care Facilities Code” for positive-pressure medical gas systems.

Retain "Brazing certificates" paragraph below if retaining "Brazing" paragraph in "Quality Assurance" Article.

* + - * 1. Brazing certificates.

Retain "Field quality control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality control reports.
				2. Source Quality Control Reports:

Retain "Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks" subparagraph below if certificates are required.

Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.

* + - 1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For [**medical**] [**and**] [**specialty**] gas piping specialties to include in emergency, operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS

This article includes compressed-air outlets and vacuum inlets, because most medical equipment has air and vacuum services as well as medical gas services.

* + - * 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Service connections in "Quick-Coupler Service Connections" subparagraph below have different configurations for each medical gas. Without an adaptor, service connections are not interchangeable among manufacturers.

Quick-Coupler Service Connections: Furnish complete noninterchangeable medical gas-pressure outlets and suction inlets.

Retain first four subparagraphs below for medical applications.

Medical Carbon Dioxide: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Medical Nitrous Oxide: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Medical Oxygen: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

<**Insert medical gas**>: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Retain first four subparagraphs below for laboratory applications.

Laboratory Carbon Dioxide: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Laboratory Nitrous Oxide: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Laboratory Oxygen: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

<**Insert medical gas**>: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Service connections in "D.I.S.S. Service Connections" subparagraph below have different threaded configurations for each medical gas and are interchangeable among manufacturers, as long as D.I.S.S. number is the same.

D.I.S.S. Service Connections: Furnish complete medical gas pressure outlets and suction inlets complying with CGA V-5 “Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)”.

Retain first five subparagraphs below for healthcare.

Medical Carbon Dioxide D.I.S.S. No. 1080: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Medical Helium D.I.S.S. No. 1060: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Medical Nitrogen D.I.S.S. No. 1120: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Medical Nitrous Oxide D.I.S.S. No. 1040: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Medical Oxygen D.I.S.S. No. 1240: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

<**Insert medical gas and D.I.S.S. No.**>: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Retain subparagraphs below for laboratory.

Laboratory Carbon Dioxide D.I.S.S. No. 1080: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Laboratory Helium D.I.S.S. No. 1060: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Laboratory Nitrogen D.I.S.S. No. 1120: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Laboratory Nitrous Oxide D.I.S.S. No. 1040: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

Laboratory Oxygen D.I.S.S. No. 1240: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

<**Insert medical gas and D.I.S.S. No.**>: Equal to <**Insert number**> percent of quantity installed, but no fewer than <**Insert number**> units.

* + - 1. QUALITY ASSURANCE
				1. Installer Qualifications:

Medical Gas Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 “Medical Gas System Installer” [**and**] [**NFPA 99**] for medical-gas-system installers.

Bulk Medical Gas Systems for Healthcare Facilities: According to ASSE Standard #6015 “Bulk Compressed Medical Gas Supply System Installers” [**and**] [**NFPA 99**] for bulk-medical-gas-system installers.

Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

Retain "Testing Agency Qualifications" paragraph below if Contractor selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control for Healthcare Facility Medical Gas" and "Field Quality Control for Laboratory Facility Specialty Gas" articles.

* + - * 1. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is[**a member of the Medical Gas Professional Healthcare Organization or is**] an NRTL, and that is acceptable to authorities having jurisdiction.

Qualify testing personnel in accordance with ASSE Standard #6020 “Medical Gas System Inspector” [**and**] [**NFPA 99**] for medical-gas-system inspectors and ASSE Standard #6030 “Medical Gas System Verifier” for medical-gas-system verifiers.

Retain "Brazing" paragraph below if retaining "Brazing certificates" paragraph in "Informational Submittals" Article.

* + - * 1. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications," or AWS B2.2 “Brazing Procedure and Performance Qualification”.
1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. SYSTEM DESCRIPTION
				1. [**Medical] [and] [laboratory**] carbon dioxide operating at [**50 to 55 psig**] <**Insert values**>.
				2. [**Medical] [and] [laboratory**] helium operating at [**50 to 55 psig**] **<Insert values**>.
				3. [**Medical] [and] [laboratory**] nitrogen operating at [**160 to 185 psig**] [**higher than 200 psig] <Insert values>**.
				4. [**Medical] [and] [laboratory**] nitrous oxide operating at [**50 to 55 psig**] <**Insert values**>.
				5. [**Medical] [and] [laboratory**] oxygen operating at [**50 to 55 psig**] <**Insert values**>.

Retain paragraph below to specify laboratory specialty gases and revise Section Text throughout.

* + - * 1. Specialty <**Insert designation**> operating at [**50 to 55 psig**] <**Insert values**>.
			1. PERFORMANCE REQUIREMENTS

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: [**Gas manifolds**] [**and**] [**bulk gas storage tanks**] shall withstand the effects of earthquake motions determined in accordance with [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the [**gas manifolds**] [**and**] [**bulk gas storage tanks**] will remain in place without separation of any parts when subjected to the seismic forces specified[**and the manifolds and tanks will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor is [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

Retain the first paragraph below for gases serving laboratories.

* + - * 1. Comply with NFPA 55 “Compressed Gases and Cryogenic Fluids Code”.

Retain the paragraph below for gases serving healthcare facilities.

* + - * 1. Comply with NFPA 99 “Health Care Facilities Code”.
			1. PIPES, TUBES, AND FITTINGS

Retain piping materials in this article to match those retained in "Piping Schedule" Article.

First paragraph and first subparagraph below are mandatory for all medical gas systems in this Section. Do not delete.

* + - * 1. For all [**medical**] [**and**] [**laboratory**] gases, all positive-pressure [**medical**] [**and**] [**laboratory**] gas piping, tubing, and fittings shall have been manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Each length of tubing shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.

Fittings and other components shall be delivered manufacturer sealed and labeled and kept sealed until prepared for installation.

Caution: This Section only specifies seamless copper tubing with brazed joints for medical and laboratory gas piping systems. This tubing is also suitable for noncorrosive specialty gas piping systems. Verify and specify required piping materials if any corrosive gases are added. Note that medical and specialty gas piping systems have different gases, gas cylinders, cylinder valves, and manifolds.

* + - * 1. Copper [**Medical**] [**and**] [**Laboratory**] Gas Tube: ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, [**Type K**] [**and**] [**Type L**], seamless, drawn temper. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
				2. Wrought-Copper Fittings: ASME B16.22 “Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings”, solder-joint pressure type.
				3. Copper Unions: ASME B16.22 “Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings” or MSS SP-123 “Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube”, wrought-copper or cast-copper alloy.
				4. Cast-Copper-Alloy Flanges: ASME B16.24 “Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500 and 2500”, Class 150.

Pipe-Flange Gasket Materials: ASME B16.21 “Nonmetallic Flat Gaskets for Pipe Flanges”, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.

Flange Bolts and Nuts: ASME B18.2.1 “Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws” carbon steel.

Use of couplings in "Shape-Memory-Metal Couplings" paragraph below permits joining new piping to existing piping without requiring recertification of the whole piping system.

* + - * 1. Shape-Memory-Metal Couplings:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2838) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[CAMERON; A Schlumber Co](http://www.specagent.com/Lookup?uid=123457185634).

[Motion Industries](http://www.specagent.com/Lookup?uid=123457185633).

[Smart Tap; Smart Technology, Inc](http://www.specagent.com/Lookup?uid=123457185631).

Or equal.

Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy.

* + - 1. JOINING MATERIALS
				1. Brazing Filler Metals: AWS A5.8M/A5.8 “Filler Metals for Brazing & Braze Welding”, BCuP Series, copper-phosphorus alloys.
				2. Threaded-Joint Tape: PTFE.
			2. VALVES

Copper-alloy ball valves with copper-tube extensions, for use with copper gas tube, are available in NPS 4 (DN 100) and smaller. Wrought-copper reducer fittings are used with valves when NPS 5 (DN 125) or larger gas tube is required.

* + - * 1. General Requirements for Valves: Manufacturer cleaned, purged, and bagged in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service” for oxygen service.
				2. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gauges.

Steel Box with Aluminum Cover:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=7535) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185725).

[CONCOA](http://www.specagent.com/Lookup?uid=123457185729).

[Oxequip Health Industries; a division of Allied Healthcare Products Inc](http://www.specagent.com/Lookup?uid=123457185728).

Or equal.

Description: Formed-steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gauges and in sizes required to permit manual operation of valves.[**Medical air and medical vacuum tubing, valves, and gauges may be incorporated in zone valve boxes for medical gases.]**

Interior Finish: Factory-applied white enamel.

Cover Plate: Aluminum with frangible or removable windows.

Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, in accordance with NFPA 99 “Health Care Facilities Code”.

First two subparagraphs below are mandatory for all medical gas systems in this Section. Do not delete.

Positive-pressure medical gas valves, for all medical gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

Steel Box with Stainless Steel Cover:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=7536) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185694).

[Ohio Medical Corporation](http://www.specagent.com/Lookup?uid=123457185695).

Tri-Tech Medical.

Or equal.

Description: Formed-steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gauges and in sizes required to permit manual operation of valves.[**Medical air and medical vacuum tubing, valves, and gauges may be incorporated in zone valve boxes for medical gases.**]

Interior Finish: Factory-applied white enamel.

Cover Plate: Stainless steel with frangible or removable windows.

Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, in accordance with NFPA 99 “Health Care Facilities Code”.

Subparagraphs below are mandatory for all gas systems in this Section. Do not delete.

Positive-pressure gas valves, for all medical gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

* + - * 1. Ball Valves:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2841) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Apollo Valves; a part of Aalberts Integrated Piping Systems](http://www.specagent.com/Lookup?uid=123457185637).

[NIBCO INC](http://www.specagent.com/Lookup?uid=123457185638).

Test.

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185639)

Or equal.

Standard: MSS SP-110 “Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends”.

Description: Three-piece body, brass, or bronze.

Pressure Rating: 300 psig minimum.

Ball: Full-port, chrome-plated brass.

Seats: PTFE or TFE.

Retain locking-type handle in "Handle" subparagraph below if required.

Handle: Lever[ **type with locking device**].

Stem: Blowout proof with PTFE or TFE seal.

Ends: [**Manufacturer-installed ASTM B819, copper-tube extensions] [and] [manufacturer-installed ASTM B819, copper-tube extensions with pressure gauge on one copper-tube extension**].

Subparagraphs below are mandatory for all medical gas systems in this Section. Do not delete.

Positive-pressure gas valves, for all medical gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

* + - * 1. Check Valves:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2843) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185644).

[Apollo Valves; a part of Aalberts Integrated Piping Systems](http://www.specagent.com/Lookup?uid=123457185646).

[NIBCO INC](http://www.specagent.com/Lookup?uid=123457185652).

Or equal.

Description: In-line pattern, bronze.

Pressure Rating: 300 psig minimum.

Operation: Spring loaded.

Ends: Manufacturer-installed ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, copper-tube extensions.

Subparagraphs below are mandatory for all gas systems in this Section. Do not delete.

Positive-pressure gas valves, for all gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

* + - * 1. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2914) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185653).

[Ohio Medical Corporation](http://www.specagent.com/Lookup?uid=123457185655).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185657).

Or equal.

Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet.”

Inlets in "Inlet" subparagraph below are also available in NPS 1/2 and NPS 3/4 (DN 15 and DN 20).

Inlet: Manufacturer-installed, 1 inch or 1-1/4 inch, ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, copper tubing with 1 inch minimum ball valve.

Safety Valve: Bronze-body pressure-relief valve set at 75 or 80 psig.

Instrumentation: Pressure gauge.

Subparagraphs below are mandatory for all gas systems in this Section. Do not delete.

Positive-pressure gas valves, for all gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

* + - * 1. Gas Safety Valves:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=13535) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185720).

[Apollo Valves; a part of Aalberts Integrated Piping Systems](http://www.specagent.com/Lookup?uid=123457185717).

Or equal.

Bronze body.

ASME-construction, poppet, pressure-relief type.

Settings to match system requirements.

Subparagraphs below are mandatory for all gas systems in this Section. Do not delete.

Positive-pressure gas valves, for all gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

* + - * 1. Pressure Regulators:

[**Bronze**] [**Stainless steel**] body and trim.

Spring-loaded, diaphragm-operated, relieving type.

Manual pressure-setting adjustment.

Rated for [**250-psig**] <**Insert value**> minimum inlet pressure.

Capable of controlling delivered gas pressure within 0.5 psig for each 10-psig inlet pressure.

Subparagraphs below are mandatory for all gas systems in this Section. Do not delete.

Positive-pressure gas valves, for all gas types, shall be manufacturer cleaned, purged, and sealed for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

* + - 1. GAS-SERVICE CONNECTIONS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13532) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185697).

[Ohio Medical Corporation](http://www.specagent.com/Lookup?uid=123457185701).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185699).

Or equal.

* + - * 1. General Requirements for [**Medical**] [**and**] [**Laboratory**] Gas-Service Connections:

All positive-pressure gas-service connections, for all gas types, shall be manufacturer cleaned, purged, and sealed as for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Suitable for specific gas pressure and suction service listed.

Include roughing-in assemblies, finishing assemblies, and cover plates.

Recessed-type units made for concealed piping unless otherwise indicated.

* + - * 1. Roughing-in Assembly:

Steel outlet box for recessed mounting and concealed piping.

Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.

Double seals that will prevent gas leakage.

ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, 3/8 inch copper outlet tube brazed to valve with service marking and tube-end dust cap.

* + - * 1. Finishing Assembly:

Brass housing with primary check valve.

Double seals that will prevent gas leakage.

Cover plate with gas-service label.

Wall service connections are typically quick-coupler type for new projects. Match existing outlet type if required.

* + - * 1. Quick-Coupler Pressure Service Connections: Outlets for [**carbon dioxide**] [**nitrous oxide**] [**and**] [**oxygen**] <**Insert type of gas**> with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
				2. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.

Medical Carbon Dioxide: D.I.S.S. No. 1080.

Medical Helium: D.I.S.S. No. 1060.

Medical Nitrogen: D.I.S.S. No. 1120.

Medical Nitrous Oxide: D.I.S.S. No. 1040.

Medical Oxygen: D.I.S.S. No. 1240.

<**Insert medical gas**>: <**Insert D.I.S.S. No.**>.

* + - * 1. Cover Plates: One piece, [**aluminum**] [**or**] [**stainless steel**] and permanent, color-coded, identifying label matching corresponding service.
			1. PATIENT-SERVICE CONSOLES

Indicate on Drawings number and type of services required, coordinate electrical requirements with electrical Drawings, and coordinate this article with medical equipment specifications and architectural Drawings. Other variations are available.

Copy "Patient-Service Consoles" paragraph below and re-edit for each type of recessed and semirecessed service console required.

Insert number to complete drawing designation. Use these designations on Drawings to identify each patient-service console.

* + - * 1. Patient-Service Consoles <**Insert drawing designation>: [Recessed] [Semirecessed] [Surface**] mounted.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2916) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185661).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185660).

Or equal.

Manufacturer cleaned, purged, and sealed, for all medical gas types, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Standard: UL 60601 “Standards for Medical Devices”.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.

General Requirements for Patient-Service Consoles: Wall units with service connections. Include labels indicating services as well as the following:

Steel console box or mounting bracket.

Concealed supplies.

Cover: One piece, [**aluminum**] [**plastic**] [**or**] [**stainless steel**] and permanent identifying label.

Medical gas-service connections, as specified in "Gas-Service Connections" Article.

Coordinate "Medical Oxygen," "Medical Air," "Medical Vacuum," and "Medical Vacuum Bottle Bracket(s)" subparagraphs below with Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" and Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities."

Medical Oxygen: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1240**] pressure outlet(s).

Medical Air: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1160**] quick-coupler pressure outlet(s).

Medical Vacuum: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1220**] suction inlet(s).

Medical Vacuum Bottle Bracket(s): [**One**] <**Insert number**>.

Electrical Service Connections:

General Requirements for Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Power Outlets: UL 498 “Standard for Safety Attachment Plugs and Receptacles”, Hospital Grade, 125 V ac, [**single**] [**duplex**] receptacle(s)[**; in color selected by Architect**]. Include the following configurations in accordance with NEMA WD 1 “General Color Requirements for Wiring Devices”:

[**One**] <**Insert number**> L5-20R, locking type, 20 A, single or duplex.

[**One**] <**Insert number**> L5-20R, isolated ground, locking type, 20 A, single or duplex.

<**Insert outlet type**>.

Electrical Accessory Outlets: Provide the following configured receptacles[**in color selected by Architect**]:

Patient Equipment Ground Jack: [**One**] <**Insert number**>, single pole, 30 A.

Patient Monitoring: [**One**] <**Insert number**>, single, [**five**] [**and**] [**37**] <**Insert number**> pin.

<**Insert outlet type**>.

Outlet Cover Plates: One piece, [**aluminum**] [**or**] [**stainless steel**] and permanent identifying label.

* + - 1. NITROGEN PRESSURE-CONTROL PANELS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13533) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185706).

[Ohio Medical Corporation](http://www.specagent.com/Lookup?uid=123457185708).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185705).

Or equal.

* + - * 1. Description: Steel box and support brackets for recessed roughing-in, with stainless steel or anodized-aluminum cover plate with printed operating instructions.
				2. Manifold: Assembly consisting of inlet supply valve, inlet supply pressure gauge, line-pressure control regulator, outlet supply pressure gauge, D.I.S.S. service connection, and piping outlet for remote service connection.
				3. Minimum Working Pressure: [**200 psig**] <**Insert value**>.
				4. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
				5. Pressure Gauges: 0 to 300 psig.
				6. Service Connection: CGA V-5 “Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)”, D.I.S.S. No. 1120, nitrogen outlet.
				7. Before final assembly, provide temporary dust shield and U-tube for testing.
				8. Label cover plate "Nitrogen Pressure Control."
				9. Manufacturer cleaned, purged, and sealed, for all gas types, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.
			1. CEILING COLUMNS

Indicate on Drawings number and type of services required, coordinate electrical requirements with electrical Drawings, and coordinate this article with medical equipment specifications and architectural Drawings. Other variations are available.

* + - * 1. Ceiling Columns <**Insert drawing designation>: [Retractable] [Stationary**].

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2919) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185663).

[Oxequip Health Industries; a division of Allied Healthcare Products Inc](http://www.specagent.com/Lookup?uid=123457185667).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185666).

Or equal.

* + - * 1. Description

Retain one of first two subparagraphs below. First subparagraph is for retractable ceiling columns.

Manually adjustable, using release and lock handles capable of locking column in all positions from fully retracted to fully extended; [**15-inch-**] <**Insert dimension**> long, rectangular, counterbalanced, telescoping section with [**two**] [**four**] <**Insert number**> double intravenous medication hooks; and [**36-inch-**] <**Insert dimension**> long fixed column section. Include 0.078-inch- thick, stainless steel bottom plate with medical gas and electrical service connections as required.

First subparagraph below is for stationary ceiling columns. Revise length of service column for required height above floor to bottom of unit.

[**44-inch-**] <**Insert dimension**> long, rectangular stationary column section with [**two**] [**four**] <**Insert number**> double intravenous medication hooks. Include 0.078-inch- thick, stainless steel bottom plate with medical gas and electrical service connections as required.

Medical Gas-Service Connections: As specified in "Gas-Service Connections" Article. Include labels indicating services.

Revise number and type of service connections required in "Medical Carbon Dioxide," "Medical Helium," "Medical Nitrogen," "Medical Nitrous Oxide," "Medical Oxygen," "Instrument Air," "Medical Air," "Medical Vacuum," "Medical Vacuum Bottle Brackets," and "WAGD," subparagraphs below. Service connections can also be side mounted.

Medical Carbon Dioxide: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1080**] pressure outlet(s).

Medical Helium: [**One**] <**Insert number**> D.I.S.S. No. 1060 pressure outlet(s).

Medical Nitrogen: [**One**] <**Insert number**> D.I.S.S. No. 1120 pressure outlet(s).

Medical Nitrous Oxide: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1040**] pressure outlet(s).

Medical Oxygen: [**Two**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1240**] pressure outlets.

Instrument Air: [**One**] <**Insert number**> D.I.S.S. No. 1160 pressure outlet(s).

Medical Air: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1160**] pressure outlet(s).

Medical Vacuum: [**Two**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 1220**] suction inlets.

Medical Vacuum Bottle Brackets: [**Two**] <**Insert number**>.

WAGD: [**One**] <**Insert number**> [**quick-coupler**] [**D.I.S.S. No. 2220**] suction inlet(s).

<**Insert medical gas**>: <**Insert number and type**>.

Standard: UL 60601 “Standards for Medical Devices”.

Manufacturer cleaned, purged, and sealed, for all medical gas type, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a qualified testing agency, and marked for intended location and application.

Mounting: Ceiling-mounted units.

Ceiling-Mounted Plate: Manufacturer's standard plate or roughing-in assembly.

Exposed Surfaces: Minimum 0.0375-inch- thick stainless steel.

Servicing: Include access panels or means of removing shroud.

Blank cover plates for cutouts not having service connections.

ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, 3/8 inch copper-tube extensions for connection to medical gas systems.

Service Connections: Type and number indicated.

Dust Covers: For medical gas-service connections.

Electrical Service Connections:

Power Outlets: UL 498 “Standard for Safety Attachment Plugs and Receptacles”, Hospital Grade, 125 V ac, [**single**] [**duplex**] receptacle(s)[**; in color selected by Director’s Representative**]. Include the following configurations in accordance with NEMA WD 1 “General Color Requirements for Wiring Devices”:

[**One**] [**Two**] <**Insert number**> L5-20R, locking type, 20 A, single or duplex.

[**One**] [**Two**] <**Insert number**> L5-20R, isolated ground, locking type, 20 A, single or duplex.

<**Insert outlet type**>.

If explosive anesthesia is used, retain first subparagraph below.

[**One**] [**Two**] <**Insert number**> explosion proof, 20 A, two pole, three wire, single; suitable for Class I, Group C hazardous location and interchangeable with receptacles used in nonhazardous areas; flush mounted.

<**Insert outlet type**>.

Retain types in first two subparagraphs below for side mounting only.

[**One**] [**Two**] <**Insert number**> 5-20R, straight blade, 20 A, duplex.

[**One**] [**Two**] <**Insert number**> 5-20R, isolated ground, straight blade, 20 A, duplex.

<**Insert outlet type**>.

Electrical Accessory Outlets: Provide the following configured receptacles[**in color selected by Architect**]:

Patient Equipment Ground Jack: [**One**] <**Insert number**>, single pole, 30 A.

Patient Monitoring: [**One**] <**Insert number**>, single, [**five**] [**and**] [**37**] <**Insert number**> pin.

<**Insert outlet type**>.

Outlet Cover Plates: One piece, [**aluminum**] [**or**] [**stainless steel**] and permanent identifying label.

* + - 1. GAS MANIFOLDS

Caution: Medical and specialty gas piping systems have different gases, gas cylinders, cylinder valves, and manifolds. Do not use these medical gas manifolds for reserve supply to bulk gas storage systems.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13534) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Acme Cryogenics](http://www.specagent.com/Lookup?uid=123457185710).

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185711).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185713).

Or equal.

* + - * 1. Manufacturer cleaned, purged, and sealed, for all medical gas type, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.
				2. Comply with NFPA 99 “Health Care Facilities Code” for high-pressure medical gas cylinders.
				3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
				4. Central Control-Panel Unit:

Weatherproof cabinet.

Supply and delivery pressure gauges.

Electrical alarm-system connections and transformer.

Indicator lights or devices.

Manifold connection.

Pressure changeover switch.

Line-pressure regulator.

Shutoff valves.

Safety valve.

* + - * 1. Manifold and Headers:

Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.

Designed for [**2000-psig**] <**Insert value**> minimum inlet pressure, except nitrous oxide manifolds may be designed for [**800 psig**] <**Insert value**>, and carbon dioxide manifolds may be designed for [**1500 psig**] <**Insert value**>.

Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1 “Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections”.

Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gauge.

* + - * 1. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
				2. Mounting: [**Wall with mounting brackets for manifold control cabinet and headers] [Floor with support legs for manifold control cabinet**].

Use label in first paragraph below with nonstandard system pressures. Label can also indicate special service requirements.

* + - * 1. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.
				2. [**Laboratory**] [**and**] [**Medical**] Carbon Dioxide Manifolds: For [**two**] [**four**] <**Insert number**> cylinders and [**55-psig**] <**Insert value**> line pressure.
				3. [**Laboratory**] [**and**] [**Medical**] Helium Manifolds: For [**two**] [**four**] <**Insert number**> cylinders and [**55-psig**] <**Insert value**> line pressure.
				4. [**Laboratory] [and] [Medical**] Nitrogen Manifolds: For [**eight] [12] <Insert number**> cylinders and [**180-psig**] [higher than **200-psig**] <**Insert value**> line pressure.
				5. [**Laboratory**] [**and**] [**Medical**] Nitrous Oxide Manifolds: For [**eight**] [**12**] <**Insert number**> cylinders and [**55-psig**] <**Insert value**> line pressure, with electric heater or orifice design that will prevent freezing during high demand.
				6. [**Laboratory**] [**and**] [**Medical**] Oxygen Manifolds: For [**12**] [**20**] <**Insert number**> cylinders and [**55-psig**] <**Insert value**> line pressure.
				7. [**Laboratory] [and] [Medical**] Gas Cylinders: [**Furnished by Owner] [Number and type of medical gas cylinders required for complete manifold systems] <Insert requirement**>.
			1. SIMPLEX SPECIALTY GAS MANIFOLDS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6204) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Acme Cryogenics](http://www.specagent.com/Lookup?uid=123457185673).

[Air Products and Chemicals, Inc](http://www.specagent.com/Lookup?uid=123457185670).

[CONCOA](http://www.specagent.com/Lookup?uid=123457185679).

[Praxair Technology, Inc](http://www.specagent.com/Lookup?uid=123457185675).

Or equal.

* + - * 1. Manufacturer cleaned, purged, and sealed, for all medical gas type, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.
				2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
				3. Control-Panel Unit: Weatherproof cabinet, supply and delivery pressure gauges, electrical alarm-system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
				4. Manifold and Header: Nonferrous-metal header for number of cylinders indicated. Units include design for [**2000-psig**] <**Insert value**> minimum inlet pressure, cylinder-bank header with inlet (pigtail) connections complying with CGA V-1 “Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections”, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gauge.
				5. Mounting: [**Wall with mounting brackets for manifold control cabinet and header] [Floor with support legs for manifold control cabinet**].
				6. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.

Copy first paragraph below and re-edit for each simplex specialty gas manifold. Insert or delete manifold types below to suit Project.

* + - * 1. <**Insert specialty gas**> Manifold: For one cylinder and [**55-psig**] <**Insert value**> line pressure, with electric heater or orifice design that will prevent freezing during high demand.
				2. Specialty Gas Cylinders: [**Furnished by Owner] [Number and type of specialty gas cylinders required for complete manifold systems] <Insert requirement**>.
			1. DUPLEX SPECIALTY GAS MANIFOLDS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6205) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Acme Cryogenics](http://www.specagent.com/Lookup?uid=123457185687).

[Air Products and Chemicals, Inc](http://www.specagent.com/Lookup?uid=123457185680).

[CONCOA](http://www.specagent.com/Lookup?uid=123457185691).

Or equal.

* + - * 1. Manufacturer cleaned, purged, and sealed, for all gas types, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.
				2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 “Standard for Electrical Safety in the Workplace”, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
				3. Central Control-Panel Unit: Weatherproof cabinet, supply and delivery pressure gauges, electrical alarm-system connections and transformer, indicator lights or devices, manifold connection, line-pressure regulator, shutoff valves, and safety valve.
				4. Manifold and Headers: Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Units include design for [**2000-psig**] <**Insert value**> minimum inlet pressure, cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1 “Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections”, individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gauge.
				5. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
				6. Mounting: [**Wall with mounting brackets for manifold control cabinet and headers] [Floor with support legs for manifold control cabinet**].
				7. Label manifold control unit with permanent label identifying specialty gas type and system operating pressure.

Copy first paragraph below and re-edit for each duplex specialty gas manifold. Insert or delete manifold types below to suit Project.

* + - * 1. <**Insert specialty gas**> Manifold: For two cylinders and [**55-psig**] <**Insert value**> line pressure, with electric heater or orifice design that will prevent freezing during high demand.
				2. Specialty Gas Cylinders: [**Number and type of specialty gas cylinders required for complete manifold systems] <Insert requirement**>.
			1. BULK MEDICAL GAS STORAGE TANKS

Retain this article to require Contractor to provide bulk storage tanks. Tanks are usually provided by gas supplier, or the healthcare facility will have a bulk oxygen storage system and may have a bulk nitrous oxide storage system. Bulk gas storage tanks are also available, if required, for specialty gases.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6206) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Acme Cryogenics](http://www.specagent.com/Lookup?uid=123457185730).

[Chart Industries](http://www.specagent.com/Lookup?uid=123457185732).

[Taylor-Wharton](http://www.specagent.com/Lookup?uid=123457185731).

Or equal.

* + - * 1. General Requirements for Bulk Medical Gas Storage Tanks:

Manufacturer cleaned, purged, and sealed, for all gas types, for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1; and NFPA 99 “Health Care Facilities Code”.

Include bulk storage tank with connections for alarm system, continuous supply, and reserve supply that will operate only during emergencies.

Controls: Include actuating switch for alarm-system connection and means for automatic actuating of reserve supply.

Bulk Gas Storage Tanks: Vertical mounted, double-wall construction with inner vessel fabricated in accordance with ASME Boiler and Pressure Vessel Code for unfired pressure vessels and suitable for gas service. Include insulation and vacuum seal between walls. Fabricate outer shell from carbon steel with factory-applied manufacturer's standard protective paint finish suitable for exterior installation. Include the following features, specialties, and components:

Safety Valves: ASME construction with pressure setting to correspond to tank working pressure and as required for component or system being protected.

Pressure Gauges: For tank pressure and facility service-line pressure.

Contents Gauge: High- and low-level indicator with electric signal circuit connection.

Drain Valves: For piping, inner vessel, and outer shell.

Fill Assembly: Fill connection, piping, valves, relief devices, and controls.

Facility Service Assembly: Piping, valves, relief devices, vaporizer, shutoff valve, pressure regulator, line shutoff valve or check valve, and reserve supply connection for connection to building service piping.

Permanent label showing medical gas type, storage-tank capacity, tank pressure rating, vaporizer capacity, and operating instructions.

* + - * 1. Liquid Oxygen Storage Tank:

Comply with NFPA 55 “Compressed Gases and Cryogenic Fluids Code” for bulk oxygen storage tanks.

Construction: Nickel-steel or stainless steel inner vessel with [**250-psig**] <**Insert value**> minimum working pressure.

Retain "Steam" option in "Vaporizer Type" subparagraph below for large flow if available; otherwise, retain "Electric" option. Retain "Ambient" option for small flow.

Vaporizer Type: [**Electric**] [**Steam**] [**Ambient**].

Storage-Tank Capacity: [**As indicated**] <**Insert value**>.

Vaporizer Capacity: [**As indicated**] <**Insert value**>.

* + - * 1. Oxygen Reserve Supply: Manifold header for high-pressure cylinders fabricated from copper-tube or brass pipe and fittings and suitable for pressures of up to [**4000 psig**] <**Insert value**>. Include header inlet connections complying with CGA V-1 “Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections”, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gauge, and inlet connections for <**Insert number**> cylinders indicated.
				2. Liquid Nitrous Oxide Storage Tank:

Comply with CGA G-8.1 “Standard for Nitrous Oxide Systems at Customer Sites” for bulk nitrous oxide storage tanks.

Construction: Steel-alloy inner vessel with [**300-psig**] <**Insert value**> minimum working pressure.

Retain "Steam" option in "Vaporizer Type" subparagraph below for large flow if available.

Vaporizer Type: [**Electric**] [**Steam**].

Storage Tank Capacity: [**As indicated**] <**Insert value**>.

Vaporizer Capacity: [**As indicated**] <**Insert value**>.

* + - * 1. Nitrous Oxide Reserve Supply: Manifold header for high-pressure cylinders fabricated from copper-tube or brass pipe and fittings and suitable for pressures of up to [**4000 psig**] <**Insert value**>. Include header inlet connections complying with CGA V-1 “Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections”, with individual inlet check valves, header shutoff valve, header pressure regulator, line shutoff valve or check valve, pressure gauge, inlet connections for <**Insert number**> cylinders indicated, and electric heater.
			1. GAS CYLINDER STORAGE RACKS

Retain this article if storage racks are required; detail storage racks on Drawings.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13536) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Airgas; an Air Liquide company](http://www.specagent.com/Lookup?uid=123457185722).

[RT Racking Systems](http://www.specagent.com/Lookup?uid=123457185721).

[USA Safety](http://www.specagent.com/Lookup?uid=123457185723).

Or equal.

* + - * 1. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders, as indicated, or provide equivalent manufactured wall racks.
				2. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.
				3. Anchor holes in base to permit securing to the floor with anchor bolts supplied by the manufacturer.
				4. Rack Support Tubing: Minimum 2-inch by 2-inch by 1/8-inch tube steel finished with baked-on exterior grade polyurethane powder paint. All joints wrap-welded and polished.
				5. Tank Restraints: Dual minimum 5/16-inch steel welded link chain, electrically zinc-plated rated for 1,900 pounds with minimum 5/16-inch zinc-plated carabineer hooks rated for minimum 520 pounds.
				6. Comply with NFPA 55 “Compressed Gases and Cryogenic Fluids Code”.
				7. Comply with NFPA 99 “Health Care Facilities Code”.
				8. Comply with OSHPD #OPA-2878-10.
1. EXECUTION
	* + 1. PREPARATION
				1. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

Revise procedures in subparagraphs below if required by authorities having jurisdiction.

Clean medical gas tube and fittings, valves, gauges, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.

Scrub to ensure complete cleaning.

Rinse with clean, hot water to remove cleaning solution.

* + - 1. PIPING INSTALLATION

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. General Location and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

Retain first paragraph below if piping installation is required for healthcare applications.

* + - * 1. Comply with NFPA 99 “Health Care Facilities Code” for installation of medical gas piping.

Retain first paragraph below if piping installation is required for laboratory applications.

* + - * 1. Comply with NFPA 55 “Compressed Gases and Cryogenic Fluids Code” for installation of laboratory gas piping.
				2. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
				3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
				4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
				5. Install piping adjacent to equipment and specialties to allow service and maintenance.
				6. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
				7. Install piping to permit valve servicing.
				8. Install piping free of sags and bends.
				9. Install fittings for changes in direction and for branch connections.
				10. Install medical gas piping to medical gas-service connections specified in this Section, to medical gas-service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
				11. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.

Retain "Piping Restraint Installation" paragraph below if piping is required to withstand seismic design loads.

* + - * 1. Piping Restraint Installation: Install seismic restraints on piping.
				2. Install medical gas-service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
				3. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
				4. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.
				5. Install sleeves for piping penetrations of walls, ceilings, and floors.

Retain first paragraph below for piping that penetrates an exterior concrete wall or concrete slab.

* + - * 1. Install sleeve seals for piping penetrations of concrete walls and slabs.
				2. Install escutcheons for piping penetrations of walls, ceilings, and floors.
			1. VALVE INSTALLATION
				1. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
				2. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
				3. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
				4. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.
				5. Install pressure regulators on gas piping where reduced pressure is required.
				6. Install emergency oxygen connection with pressure-relief valve and full-size discharge piping to outside, with check valve downstream from pressure-relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.
			2. JOINT CONSTRUCTION
				1. Ream ends of pipes and tubes and remove burrs.
				2. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
				3. Threaded Joints: Apply appropriate tape to external pipe threads.
				4. Brazed Joints: Join copper tube and fittings in accordance with CDA's "Copper Tube Handbook," Ch. "Brazed Joints." Do not use flux. Continuously purge joint with oil-free, dry nitrogen during brazing.
				5. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.
				6. Soldered Joints: Apply ASTM B813 “Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube”, water-flushable flux to tube end. Join copper tube and fittings in accordance with ASTM B828 “Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings”.
				7. Extruded-Tee Outlets: Form branches in copper tube in accordance with ASTM F2014 “Standard Specifications for Non-Reinforced Extruded Tee Connections for Piping Applications”, with tools recommended by tube manufacturer.
				8. Flanged Joints:

Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 “Building Services Piping” for bolting procedure.

PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts in accordance with ASME B31.9 “Building Services Piping” for bolting procedure.

* + - 1. GAS-SERVICE COMPONENT INSTALLATION
				1. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.
				2. Install nitrogen pressure-control panels in walls. Attach to substrate.
				3. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
				4. Assemble ceiling-hose assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
				5. Install gas manifolds[**on concrete base**] anchored to substrate.

Retain first paragraph below if Contractor provides gas cylinders.

* + - * 1. Install gas cylinders and connect to manifold piping.

Indicate seismic restraints on Drawings if required, or delete first paragraph below.

* + - * 1. Install gas manifolds with seismic restraints.

Retain option in first paragraph below if bulk oxygen storage tank is specified.

* + - * 1. Install bulk gas storage tanks and reserve supply tanks level on concrete bases. Set tanks and connect gas piping to tanks[**in accordance with applicable requirements in NFPA 55 for bulk oxygen storage systems**]. Install tanks level and plumb, firmly anchored to concrete bases; maintain NFPA 55 “Compressed Gases and Cryogenic Fluids Code” and tank manufacturer's recommended clearances. Orient tanks, so controls and devices are accessible for servicing.

Indicate seismic restraints on Drawings if required, or delete paragraph below.

* + - * 1. Install bulk gas storage tanks and reserve supply tanks with seismic restraints.
			1. INSTALLATION OF HANGERS AND SUPPORTS

Retain first paragraph below for projects in areas that require seismic restraints.

* + - * 1. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
				3. Vertical Piping: MSS Type 8 or Type 42, clamps.
				4. Individual, Straight, Horizontal Piping Runs:

100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.

Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

* + - * 1. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
				2. Base of Vertical Piping: MSS Type 52 spring hangers.
				3. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters to comply with MSS SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation”, NFPA 99 “Health Care Facilities Code”, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				4. Support horizontal piping within [**12 inches**] <**Insert dimension**> of each fitting and coupling.
				5. Support vertical runs of copper tubing to comply with MSS SP-58 “Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation”, NFPA 99 “Health Care Facilities Code”, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
			1. IDENTIFICATION
				1. Install identifying labels and devices for specialty gas piping, valves, and specialties.
				2. Install identifying labels and devices for healthcare medical gas piping systems in accordance with NFPA 99 “Health Care Facilities Code”. Use the following or similar captions and color-coding for piping products where required by NFPA 99 “Health Care Facilities Code”:

Carbon Dioxide: Black or white letters on gray background.

Helium: White letters on brown background.

Nitrogen: White letters on black background.

Nitrous Oxide: White letters on blue background.

Oxygen: White letters on green background or green letters on white background.

* + - 1. FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

Retain "Testing Agency," "Manufacturer's Field Service," "Perform tests and inspections," or "Tests and Inspection" paragraph below.

* + - * 1. Testing Agency:

Retain first subparagraph below if Director’s Representative will hire an independent testing agency.

Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Retain subparagraph below to require Contractor to hire an independent testing agency.

Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a Company Service Advisor to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Service Advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" paragraph below to require Contractor to perform tests and inspection, and retain option to require Contractor to arrange for the assistance of a Company Service Advisor.

* + - * 1. Perform tests and inspections with Company Field Advisor.

Retain test requirements below with any combination of paragraphs above.

* + - * 1. Tests and Inspections:

Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of [**medical compressed-air piping**] [**and**] [**medical vacuum piping**] systems.

Tests in "Preparation" subparagraph below are required by Installer before verification by testing agency.

Preparation: Perform the following Installer tests according to requirements in NFPA 99 “Health Care Facilities Code” and ASSE Standard #6010 “Medical Gas System Installer”:

Initial blowdown.

Initial pressure test.

Cross-connection test.

Piping purge test.

Standing pressure test for positive-pressure medical gas piping.

Standing pressure test for vacuum systems.

Repair leaks and retest until no leaks exist.

System Verification: Perform the following tests and inspections in accordance with NFPA 99 “Health Care Facilities Code”, ASSE Standard #6020 “Medical Gas System Inspector”, and ASSE Standard #6030 “Medical Gas System Verifier”:

Standing pressure test.

[**Individual-pressurization**] [**or**] [**pressure-differential**] cross-connection test.

Valve test.

Master and area alarm tests.

Piping purge test.

Piping particulate test.

Piping purity test.

Final tie-in test.

Operational pressure test.

Gas concentration test.

Air-purity test.

Verify correct labeling of equipment and components.

Verify medical gas supply sources.

Revise "Testing Certification" subparagraph below for exact testing certification required.

Testing Certification: Certify that specified tests, inspections, and procedures have been performed, and certify report results. Include the following:

Inspections performed.

Procedures, materials, and gases used.

Test methods used.

Results of tests.

* + - * 1. Piping will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

Retain "Testing Agency," "Manufacturer's Field Service," "Perform tests and inspections," or "Tests and Inspection" paragraph below.

* + - * 1. Testing Agency:

Retain first subparagraph below if Director’s Representative will hire an independent testing agency.

Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Retain subparagraph below to require Contractor to hire an independent testing agency.

Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a Company Service Advisor to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" paragraph below to require Contractor to perform tests and inspection, and retain option to require Contractor to arrange for the assistance of a Company Service Advisor.

* + - * 1. Perform tests and inspections[ **with Company Field Advisor per OGS Spec Section 014216**].

Retain test requirements below with any combination of paragraphs above.

* + - * 1. Tests and Inspections:

Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig above system operating pressure, but not less than [**150 psig**] <**Insert value**>. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

Repair leaks and retest until no leaks exist.

Inspect specialty gas regulators for proper operation.

* + - * 1. Piping will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. PROTECTION
				1. Protect tubing from damage.
				2. Retain sealing plugs in tubing, fittings, and specialties until installation.
				3. Clean tubing not properly sealed, and where sealing is damaged, in accordance with "Preparation" Article.
			2. DEMONSTRATION

Retain this article only if bulk gas storage tanks are specified in this Section.

* + - * 1. Engage Company Field Advisor to train Director’s Representative's maintenance personnel to adjust, operate, and maintain bulk gas storage tanks.
			1. PIPING SCHEDULE

Retain and revise piping applications in this article to suit Project. Coordinate with materials specified.

* + - * 1. Connect new tubing to existing tubing with memory-metal couplings.

Retain "Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig " paragraph below for medical gases. Piping in first paragraph below includes medical carbon dioxide, medical helium, medical nitrous oxide, and medical oxygen.

* + - * 1. Medical Gas Piping except Medical Nitrogen Piping Larger Than 3 inch and Operating at More Than 185 psig: Type L, copper tube; wrought-copper fittings; and brazed joints.
				2. Medical Nitrogen Piping Larger Than 3 inch and Operating at More Than 185 psig: Type K, copper tube; wrought-copper fittings; and brazed joints.
				3. Specialty Gas Piping except Specialty Gas Larger Than 3 inch and Operating at More Than 185 psig: Type L, copper tube; wrought-copper fittings; and brazed joints.
				4. Specialty Gas Piping Larger Than 3 inch and Operating at More Than 185 psig: Type K, copper tube; wrought-copper fittings; and brazed joints.

Retain "Laboratory Gas Piping except Laboratory Nitrogen Piping NPS 3 (DN 80) and smaller Operating at More Than 185 psig " paragraph below for laboratory gasses. Piping in first paragraph below includes carbon dioxide, helium, nitrous oxide, and oxygen.

* + - * 1. Laboratory Gas Piping except Laboratory Nitrogen Piping 3 inch and Smaller Shall Operate at More Than 185 psig: Type L, copper tube; wrought-copper fittings; and brazed joints.
				2. Laboratory Nitrogen Piping 3 inch and Smaller Shall Operate at More Than 185 psig: Type K, copper tube; wrought-copper fittings; and brazed joints.
				3. <**Insert specialty gas**> Piping except Specialty Gas 3 inchand Smaller Shall Operate at More Than 185 psig: Type L, copper tube; wrought-copper fittings; and brazed joints.
				4. <**Insert specialty gas**> Piping 3 inch and Smaller Shall Operate at More Than 185 psig: Type K, copper tube; wrought-copper fittings; and brazed joints.
			1. VALVE SCHEDULE
				1. Shutoff Valves: Ball valve with manufacturer-installed ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, copper-tube extensions.
				2. Zone Valves: Ball valve with manufacturer-installed ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, copper-tube extensions with pressure gauge on one copper-tube extension.

END OF SECTION 226313