SECTION 226113 – COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

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

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:

Medical compressed-air piping, designated "medical air."

Dental compressed-air piping, designated "dental air."

Gas-powered-tool compressed-air piping, designated "instrument air."

Laboratory compressed-air piping, designated "laboratory air."

Shape-memory-metal couplings.

Pressure-seal fittings.

Flexible pipe connectors.

Zone valve box assemblies.

Ball valves.

Check valves.

Gas safety valves.

Compressed-air service connections.

Compressed-air manifolds.

Compressed-air cylinder storage racks.

* + - * 1. Related Requirements:

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

Section 115313 "Laboratory Fume Hoods" for compressed-air outlets in laboratory fume hoods.

Section 123553.13 "Metal Laboratory Casework" for compressed-air outlets in laboratory casework.

Section 123553.16 "Plastic-Laminate-Clad Laboratory Casework" for compressed-air outlets in laboratory casework.

Section 123553.19 "Wood Laboratory Casework" for compressed-air outlets in laboratory casework.

Section 123570 "Healthcare Casework" for compressed-air outlets in healthcare casework.

Section 221513 "General-Service Compressed-Air Piping" for general-service compressed-air piping and specialties.

Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities" for air compressors and specialties.

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. Compressed-Air Piping Systems: Include medical air, dental air, instrument air, and laboratory air.
			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.

Coordinate "Qualification Data" paragraph below with qualification and as may be supplemented in "Quality Assurance" Article.

* + - * 1. 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 compressed-air manifolds, accessories, and components, 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 compressed-air systems for healthcare facilities.

* + - * 1. Material Certificates: Signed by Installer, certifying that medical compressed-air 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 retaining "Brazing" paragraph in "Quality Assurance" Article.

* + - * 1. Field Quality-Control Reports: Brazing certificates.
				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, Section VIII.

* + - 1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.
			2. MAINTENANCE MATERIAL SUBMITTALS
				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 (including medical air). Without an adaptor, service connections are not interchangeable among manufacturers.

Quick-Coupler Service Connections: Furnish complete noninterchangeable medical compressed-air pressure outlets.

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

Instrument Air: Equal to <**Insert number**> percent of amount 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 compressed-air-pressure outlets complying with CGA V-5 “Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)”.

Medical Air D.I.S.S. No. 1160: Equal to <**Insert number**> percent of amount installed, but no fewer than <**Insert number**> units.

Instrument Air D.I.S.S. No. 1160: Equal to <**Insert number**> percent of amount installed, but no fewer than <**Insert number**> units.

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

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

Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 “Medical Gas Systems Maintenance Personnel” [**and**] [**NFPA 99**].

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 Compressed-Air Piping in Healthcare Facilities" and "Field Quality Control for Compressed-Air Piping in Laboratory Facilities" articles.

* + - * 1. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum 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” [**and**] [**NFPA 99**] 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 air operating at [**50 to 55 psig**] <**Insert values**>.
				2. Dental air operating at [**80 to 100 psig**] <**Insert values**>.
				3. Instrument air operating at [**175 psig**] <**Insert value**>.
				4. Laboratory air operating at [**50 psig**] [**100 psig**] [**125 psig**] <**Insert value**>.
			2. 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: Compressed-air manifolds shall withstand the effects of earthquake motions determined according to [**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 manifold will remain in place without separation of any parts when subjected to the seismic forces specified[**and the manifold 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**>.

* + - * 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.

Retain this article for medical air piping materials.

* + - * 1. Comply with NFPA 99 “Health Care Facilities Code” for medical air piping materials.

subparagraph below is mandatory for all compressed-air systems in this Section. Do not delete.

All positive-pressure compressed-air piping, tubing, and fittings shall be manufacturer cleaned, purged, and sealed as 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.

Retain the first two paragraphs below for laboratory compressed-air materials.

* + - * 1. Comply with ASME B31.1 “Power Piping” for laboratory air piping operating at more than 150 psig.
				2. Comply with ASME B31.9 “Building Services Piping” for laboratory air piping operating at 150 psig or less.
				3. Copper Medical 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 "MED" or "OXY/MED" in green for Type K tube and in blue for Type L tube.
				4. Wrought-Copper Fittings: ASME B16.22 “Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings”, solder-joint pressure type.
				5. 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.
				6. 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:

[Aerofit, Inc](http://www.specagent.com/Lookup?uid=123457185255).

[CAMERON; A Schlumber Co](http://www.specagent.com/Lookup?uid=123457185257).

Approved equivalent.

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

* + - * 1. Pressure-Seal Fittings:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=1490) 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.

FNW; Ferguson Enterprises, Inc.

Approved equivalent.

NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

NPS 2-1/2 to NPS 4: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.

* + - * 1. Flexible Pipe Connectors:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2839) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Flex-Hose Co., Inc](http://www.specagent.com/Lookup?uid=123457185258).

[Flexicraft Industries](http://www.specagent.com/Lookup?uid=123457185259).

[Metraflex Company (The)](http://www.specagent.com/Lookup?uid=123457185261).

Approved equivalent.

Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

Working-Pressure Rating: [**200 psig**] [**250 psig**] minimum.

End Connections: Plain-end copper tube.

* + - 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 medical 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 medical 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=123457185241).

[CONCOA](http://www.specagent.com/Lookup?uid=123457185245).

Approved equivalent.

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 tubing, valves, and gauges may be incorporated in zone valve boxes for medical gases.**]

Subparagraph below is mandatory for all compressed-air systems in this Section. Do not delete.

Positive-pressure compressed-air valves shall have been manufacturer cleaned, purged, and sealed as 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.

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”.

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=123457185248).

[Ohio Medical Corporation](http://www.specagent.com/Lookup?uid=123457185249).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185247).

Approved equivalent.

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.**]

Subparagraph below is mandatory for all compressed air systems in this Section. Do not delete.

Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as 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.

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”.

* + - * 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:

[Amico Corporation](http://www.specagent.com/Lookup?uid=123457185267).

[Apollo Valves; a part of Aalberts Integrated Piping Systems](http://www.specagent.com/Lookup?uid=123457185269).

[NIBCO INC](http://www.specagent.com/Lookup?uid=123457185270).

Approved equivalent.

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 gage on one copper-tube extension**].

Subparagraph below is mandatory for all compressed-air systems in this Section. Do not delete.

Positive-pressure medical air valves shall be manufacturer cleaned, purged, and sealed as 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=123457185276).

[Apollo Valves; a part of Aalberts Integrated Piping Systems](http://www.specagent.com/Lookup?uid=123457185278).

[NIBCO INC](http://www.specagent.com/Lookup?uid=123457185284).

Approved equivalent.

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.

Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as 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=13093) 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=123457185291).

[Apollo Valves; a part of Aalberts Integrated Piping Systems](http://www.specagent.com/Lookup?uid=123457185292).

Approved equivalent.

Bronze body.

ASME-construction, poppet, pressure-relief type.

Settings to match system requirements.

Subparagraph below is mandatory for all compressed-air systems in this Section. Do not delete.

Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as 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. Compressed-Air Safety Valves:

Bronze body.

ASME-construction, poppet, pressure-relief type.

Settings to match system requirements.

Subparagraph below is mandatory for all compressed-air systems in this Section. Do not delete.

Positive-pressure compressed-air valves shall be manufacturer cleaned, purged, and sealed as 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 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 air pressure within 0.5 psig for each 10-psig inlet pressure.

Subparagraph below is mandatory for all compressed-air systems in this Section. Do not delete.

Positive-pressure medical air regulators shall be manufacturer cleaned, purged, and sealed as 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. MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=2844) 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=123457185285).

[Oxequip Health Industries; a division of Allied Healthcare Products Inc](http://www.specagent.com/Lookup?uid=123457185290).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185288).

Approved equivalent.

* + - * 1. General Requirements for Medical Compressed-Air Service Connections:

All positive-pressure compressed-air-service connections 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 medical air pressure and 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 air leakage.

ASTM B819 “Standard Specification for Seamless Copper Tubes for Medical Gas Systems”, NPS 3/8 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 air 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 [**medical air**] [**and**] [**instrument air**] with noninterchangeable keyed indexing to prevent interchange between services.

Constructed to permit one-handed connection and removal of equipment.

With positive-locking ring that retains equipment stem in valve during use.

Retain "D.I.S.S. Pressure Service Connections" paragraph below if medical air equipment contains air outlets.

* + - * 1. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5 “Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)”, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.

Medical Air: D.I.S.S. No. 1160.

Instrument Air: D.I.S.S. No. 1160.

* + - * 1. Cover Plates:

One piece.

[**Aluminum**] [**or**] [**stainless steel**].

Permanent, color-coded, identifying label matching corresponding service.

* + - 1. COMPRESSED-AIR MANIFOLDS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13530) 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=123457185295).

[Oxequip Health Industries; a division of Allied Healthcare Products Inc](http://www.specagent.com/Lookup?uid=123457185300).

[Tri-Tech Medical](http://www.specagent.com/Lookup?uid=123457185297).

Approved equivalent.

* + - * 1. Manufacturer cleaned, purged, and sealed as for oxygen service, in accordance with CGA G-4.1 “Cleaning Equipment for Oxygen Service”.

Retain first paragraph below for medical air applications.

* + - * 1. Comply with NFPA 99 “Health Care Facilities Code”, Ch. "Manifolds for Gas Cylinders without Reserve Supply."

Retain first paragraph below for laboratory air applications.

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

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 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 gage.

* + - * 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 compressed air and system operating pressure.
				2. Medical Air Manifolds: For [**four**] [**eight**] <**Insert number**> cylinders and [**55-psig**] <**Insert value**> line pressure.

Air manifold in "Instrument Air Manifolds" paragraph below is for use with tools requiring high-pressure air supply instead of nitrogen. Do not use this pressure for patient treatment. Tubing for this system requires label showing pressure.

* + - * 1. Instrument Air Manifolds: For [**eight**] [**12**] <**Insert number**> cylinders and [**200-psig**] <**Insert value**> minimum line pressure.
				2. Compressed-Air Cylinders: [**Furnished by Director’s Representative**] [**Number and type of compressed-air cylinders required for complete manifold systems**].
			1. COMPRESSED-AIR-CYLINDER STORAGE RACKS

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

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13531) 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=123457185252).

[RT Racking Systems](http://www.specagent.com/Lookup?uid=123457185251).

[USA Safety](http://www.specagent.com/Lookup?uid=123457185253).

Approved equivalent.

* + - * 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. Restraints: Dual minimum 5/16-inch steel welded link chain, electrically zinc-plated rated for 1,900 lbs with minimum 5/16-inch zinc-plated carabineer hooks rated for 520 lbs.
				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 Air 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 air 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 air 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 compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

Retain first paragraph below if piping is required to withstand seismic design loads.

* + - * 1. Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

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

* + - * 1. Comply with NFPA 99 “Health Care Facilities Code” for installation of compressed-air 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 piping with 1 percent slope downward in direction of flow.
				7. 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.
				8. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
				9. Install branch connections to mains from top of main. Provide drain leg at end of each main and branch at low points.
				10. Install piping to permit valve servicing.
				11. Install piping free of sags and bends.
				12. Install fittings for changes in direction and for branch connections.

Retain first paragraph below for medical air piping installation.

* + - * 1. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.

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

* + - * 1. Piping Restraint Installation: Install seismic restraints on compressed-air piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Install service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
				3. Connect piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
				4. Install unions in copper tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
				5. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
				6. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
			1. VALVE INSTALLATION
				1. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
				2. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
				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. Rotate valves to angle that prevents closure of cover when valve is in closed position.
				5. Install pressure regulators on compressed-air piping where reduced pressure is required.
				6. Install flexible pipe connectors in discharge piping[**and in inlet air piping from remote air-inlet filter**] of each air compressor.
			2. JOINT CONSTRUCTION
				1. Ream ends of pipes and tubes and remove burrs.
				2. Remove scale, slag, dirt, and debris from inside and 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. 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”.
				6. 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.
				7. 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.

* + - * 1. 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.
			1. COMPRESSED-AIR SERVICE COMPONENT INSTALLATION
				1. Install compressed-air pressure-control panel in walls. Attach to substrate.
				2. Install compressed-air manifolds[**on concrete base**] anchored to substrate.

Retain first paragraph below if Contractor provides compressed-air cylinders.

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

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

* + - * 1. Install compressed-air manifolds with seismic restraints as indicated.
				2. Install compressed-air-cylinder wall storage racks attached to substrate.
			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 laboratory compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."
				2. Install identifying labels and devices for medical compressed-air 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”:

Medical Air: Black letters on yellow background.

Dental Air: [**Black letters on yellow background**] <**Insert color code**>.

Instrument Air: White letters on red background.

Laboratory Air: Black letters on yellow-and-white checkerboard background.

* + - 1. FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

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 Owner 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 factory-authorized service representative 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 factory-authorized service agent.

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

Retain test requirements below with any combination of paragraphs above.

* + - * 1. Tests and Inspections:

Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of [**medical gas 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 in accordance with 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 compressed-air piping.

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.

Medical air-purity test.

Verify correct labeling of equipment and components.

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 COMPRESSED-AIR PIPING IN LABORATORY FACILITIES

Retain "Testing Agency," "Manufacturer's Field Service," "Perform tests and inspections," or "Tests and Inspections" paragraph below. Retain first option in "Testing Agency" paragraph below if Owner will hire an independent testing agency.

* + - * 1. Testing Agency: [**Director’s Representative will engage**] [**Engage**] qualified testing agency to perform tests and inspections of compressed-air piping in laboratory facilities and to prepare test and inspection reports.

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative 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 factory-authorized service agent.

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

Retain "Tests and Inspections" paragraph below with any combination of paragraphs above.

* + - * 1. Tests and Inspections:

Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill compressed-air 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.

* + - * 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. 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.
				2. Flanges may be used where connection to flanged equipment is required.

Piping in first paragraph below includes medical air, dental air, instrument air, and medical laboratory air piping.

Retain paragraph below for Type L copper piping and fittings.

* + - * 1. [**Medical Air Piping**] [**Instrument Air Piping**] [**and**] [**Dental Air Piping**], NPS 3 and Smaller Shall Operate between 15 psig and 50 psig: Type L copper tubing: wrought copper fittings; and brazed joints.

Retain first paragraph below for Type K copper piping and fittings.

* + - * 1. [**Medical Air Piping**] [**Instrument Air Piping**] [**and**] [**Dental Air Piping**], NPS 3 and Smaller Shall Operate between 15 psig and 50 psig: Type L copper tubing, wrought copper fittings, and brazed joints.

In "Laboratory Air Piping" paragraph below, laboratory air is for laboratory facilities in this Section.

* + - * 1. Laboratory Air Piping, NPS 3 and Smaller Shall Operate between 15 psig and 50 psig: Type L copper tubing, 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 226113