SECTION 226000 - GAS AND VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

This Section includes components for most common medical gas systems including pipe and pipe fittings, piping specialties, specialized outlets, and equipment.

Coordinate location of piping, valves, and hangers and supports with other sections in this Division. When Section 220529, and Section 220523 are used consider deleting duplicate requirements and referencing appropriate sections.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting requirements of this Specification.

This Section includes performance, proprietary, and descriptive specifications. Edit to avoid conflicting requirements.

This Section may include term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See Drawing Coordination Checklist and Evaluations for information needed to coordinate this Specification Section with Drawings.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Medical gas piping.

Valves.

Pipe hangers and supports.

Piping Specialties.

Medical gas outlets.

Medical air compressor source system.

Medical vacuum pump source system.

Instrument air source system.

Waste anesthetic gas disposal source.

Medical air compressor.

Medical vacuum pump.

Oral evacuation pumps.

Receiver.

Refrigerated air dryer.

Desiccant air dryer.

Gas cylinder manifold.

Area alarm panel.

Master alarm panel.

Liquid oxygen storage tank.

Labeling and identification.

Installer performed tests.

System verification tests.

* + - * 1. Related Sections:

Section 033000 - Cast-In-Place Concrete: Execution requirements for equipment bases specified by this section.

Use the following reference when firestopping is specified in another Division.

Section 078413 – Penetration Firestopping: Product requirements for firestopping for placement by this section.

Section 087100 - Door Hardware: Keying requirements for padlocks.

Use the following when pipe materials are specified in one location in this Division.

Section 220513 - Common Motor Requirements for Plumbing Equipment: Product requirements for equipment motors for placement by this section.

Use the following when valves are specified in one location in this Division.

Section 220523 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.

Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment: Product requirements for vibration isolators for placement by this section.

Section 220553 - Identification for Plumbing Piping and Equipment: Product requirements for underground pipe and valve identification for placement by this section.

Section 220700 - Plumbing Insulation: Product and execution requirements for pipe insulation.

Section 221100 - Facility Water Distribution: Product requirements for backflow preventers for placement by this section.

* + - * 1. Allowances: Include Price and Payment Procedures Allowances. Allowance includes purchase and delivery of bottled gases. Installation is included in this section and is part of Contract Sum/Price. Allowance also includes cost of installer performed tests and system verification tests in accordance with [**NFPA 99**] <**\_\_\_\_\_\_\_\_**>.
			1. REFERENCES

List reference standards included within text of this section. Edit the following for Project conditions.

* + - * 1. American Society of Mechanical Engineers:

ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

* + - * 1. American Society of Sanitary Engineering:

ASSE 6010 - Professional Qualification Standard for Medical Gas and Vacuum System Installers.

ASSE 6030 - Medical Gas Verifiers Professional Qualification Standard.

* + - * 1. American Welding Society:

AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

AWS B2.2 - Standard for Brazing Procedure and Performance Qualifications.

AWS D1.1 - Structural Welding Code - Steel.

* + - * 1. ASTM International:

ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

ASTM A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

ASTM A403 - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

ASTM A536 - Standard Specification for Ductile Iron Castings.

ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

ASTM B32 - Standard Specification for Solder Metal.

ASTM B88 - Standard Specification for Seamless Copper Water Tube.

ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems.

ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

* + - * 1. Compressed Gas Association:

CGA G-4.1 - Cleaning Equipment for Oxygen Service.

CGA C-7 - Guide to the Preparation for Cautionary Labeling and Marking for Compressed Gas Containers.

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

CGA V-5 - Diameter-Index Safety System (Non-Interchangeable Low Pressure Connections for Medical Gas Applications).

* + - * 1. Manufacturers Standardization Society of the Valve and Fittings Industry:

MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

MSS SP 67 - Butterfly Valves.

MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

MSS SP 73 - Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings.

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

* + - * 1. National Electrical Manufacturers Association:

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

* + - * 1. National Fire Protection Association:

NFPA 50 - Standard for Bulk Oxygen Systems at Consumer Sites.

NFPA 99 - Health Care Facilities.

* + - * 1. Underwriters Laboratories Inc.:

Electrical Construction Equipment.

* + - 1. SYSTEM DESCRIPTION

Use this article carefully; restrict statements to describe components used to assemble system. Do not repeat statements made in SUMMARY Article, "Section includes" paragraph.

The following definitions are taken from NFPA 99, Chapter 3 Definitions. Retain in project specification or use to help edit the specification.

Level 1 Medical Piped Gas and Vacuum Systems: Systems where interruption would place patients in immediate danger.

Level 1 Vacuum Systems: Monitored system with station outlets for patient suction.

Level 2 Medical Piped Gas and Vacuum Systems: Systems where interruption would place patients at manageable risk.

Level 3 Compressed Air System: System delivering compressed air at maximum 160 psig (1100 kPa) to power devices.

Level 3 Piped Gas Systems: Systems where interruption terminates procedures but would not place patients at risk.

Level 3 Piped Vacuum System: Wet or dry vacuum systems.

* + - * 1. [**Level 1**] [**Level 2**] [**Level 3**] Medical Gas Systems include the following gas types, piping systems and equipment.
				2. Gases:

Oxygen.

Nitrous oxide.

Nitrogen.

Medical air.

Carbon dioxide.

Medical-surgical vacuum.

Waste anesthetic gas disposal.

Instrument air.

Edit the following based on facility level and systems applicable to project.

* + - * 1. Piping Systems:

Level 1 positive pressure medical gas system piping.

Level 2 positive pressure medical gas system piping.

Level 1 medical-surgical vacuum system piping.

Level 2 medical-surgical vacuum system piping.

Air compressor intake piping.

Vacuum pump exhaust piping.

Waste anesthetic gas disposal (WAGD) piping.

WAGD pump exhaust piping.

Level 1 underground protector piping.

Level 2 underground protector piping.

Level 3 positive pressure medical gas piping, aboveground.

Level 3 piping for gas-powered devices.

Level 3 positive pressure medical gas piping, buried.

Level 3 medical-surgical vacuum piping.

Medical air compressor service or seal water piping.

Medical vacuum pump seal water piping.

Relief valve vent piping.

List equipment applicable to Project.

* + - * 1. Equipment:

Valve cabinets.

Medical gas outlets.

Medical air compressor [**source system**].

Medical vacuum pump [**source system**].

Instrument air [**source system**] [**compressor**].

Waste anesthetic gas disposal [**source**] [**pump**].

Oral evacuation pumps.

Gas cylinder manifold.

Area alarm panels.

Master alarm panel.

Liquid oxygen storage tank.

* + - 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).

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Section 013300 - Submittal Procedures: Requirements for submittals.
				2. Shop Drawings:

Indicate piping system schematic with electrical and connection requirements general assembly of components, mounting and installation details.

Indicate general layout of control and alarm panels.

Indicate detailed medical wall assembly drawings.

* + - * 1. Product Data:

Piping: Submit data on pipe materials, fittings, and accessories.

Valves: Submit manufacturers catalog information with valve data and ratings for each service.

Hangers and Supports: Submit manufacturers catalog information including load capacity.

System Components: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes. When applicable, include electrical characteristics and connection requirements.

Compressors: Submit type, capacity, and performance characteristics. Include electrical characteristics and connection requirements.

Vacuum Pumps: Submit type, capacity, and performance characteristics. Include electrical characteristics and connection requirements.

* + - * 1. Product Data: Submit manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
				2. Qualifications Data: Submit documentation verifying qualifications for the following:

Brazers and brazing procedures.

Welders and welding procedures.

Medical gas [**and vacuum**] system installer.

System verifier.

Include the following paragraph for submission of physical samples for selection of finish, color, texture, and other properties.

* + - * 1. Samples: Submit [**two**] <**\_\_\_\_\_\_\_\_**> of [**each outlet**] [**each valve**].
				2. Manufacturer's Installation Instructions: Submit hoisting and setting requirements, starting procedures.
				3. Manufacturer's Certificate:

Certify [**products**] <**\_\_\_\_\_\_\_\_**> meet or exceed [**specified requirements**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**>.

Certify piping materials comply with CGA G-4.1 (Cleaning Equipment for Oxygen Service) cleaning requirements.

* + - * 1. Manufacturer's Field Reports: Indicate systems are complete, zone valves installed, and alarm systems functional.
				2. Installer's Test Reports:

Submit documentation indicating completion of Installer Performed Tests.

Submit list of each test and when test was completed.

Include documentation required by NFPA 99 (Health Care Facilities).

* + - * 1. Verifier's Test Reports:

Submit testing and inspection report of System Verification Tests.

Submit list of each test and when test was completed.

Include documentation required by NFPA 99 (Health Care Facilities).

* + - 1. CLOSEOUT SUBMITTALS
				1. Section 017700 - Closeout Procedures: Requirements for submittals.
				2. Project Record Documents: Record actual locations of equipment piping, valves, outlets and components.
				3. Operation and Maintenance Data: Submit assembly views, lubrication instructions, replacement part numbers and availability.
			2. QUALITY ASSURANCE
				1. Furnish piping, valves, [**pipe fittings,**] outlets and other piping components cleaned for oxygen service by manufacturer in accordance with CGA G-4.1 (Cleaning Equipment for Oxygen Service).
				2. Furnish documentation certifying installed piping materials comply with CGA G-4.1 (Cleaning Equipment for Oxygen Service) cleaning requirements.
				3. Perform Work in accordance with NFPA 99 (Health Care Facilities) for installation of piping systems and [**ASME Section IX**] [**AWS B2.2**] for brazing materials and procedures.
				4. Perform Work in accordance with [**authority having jurisdiction**] [**AWS D1.1**] for welding hanger and support attachments to building structure.
				5. Perform Work in accordance with [**[State] [Municipality] of <\_\_\_\_\_\_\_\_> [Highways] [Public Work's] standard.**]

Include the following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain [**one copy**] [**<\_\_\_\_\_\_\_\_> copies**] of [**each**] document on site.
			1. QUALIFICATIONS
				1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years [**documented**] experience.
				2. Installer: Company specializing in performing work of this section with minimum <**\_\_\_\_\_\_\_\_**> years [**documented**] experience [**approved by manufacturer**].

ASSE Standard 6010 qualified to install medical gas and vacuum systems.

* + - * 1. Brazers and Brazing Procedures: [**ASME Section IX**] [**AWS B2.2**] qualified within previous 12 months for medical gas and vacuum systems.
				2. Welders and Welding Procedures: AWS D1.1 (Structural Welding Code – Steel) qualified within previous 12 months for medical gas and vacuum systems.
				3. System Verifier: Company specializing in performing [**work of this section**] [**medical gas system verification**] with minimum <**\_\_\_\_\_\_\_\_**> years [**documented**] experience [**approved by manufacturer**].

ASSE Standard 6030 qualified and independent of system installer.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Perform system verification using one of the following System Verifiers:

<**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**>.

<**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**>.

<**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**>.

* + - 1. MOCKUP

Use this article for full sized erected assemblies required for review of construction, coordination of work of several sections, testing, or observation of operation.

* + - * 1. Mockup requirements.
				2. Construct mockup of [**outlets for each type of medical gas**] <**\_\_\_\_\_\_\_\_**> in [**typical patient head wall unit**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**>.
				3. Locate [**where directed by Director’s Representative.**] [**where indicated on Drawings.**]
				4. Incorporate accepted mockup as part of Work.

\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Remove mockup [**when directed by Director’s Representative.**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**>
			1. PRE-INSTALLATION MEETINGS
				1. Section 013000 - Administrative Requirements: Pre-installation meeting.
				2. Convene minimum [**one**] <**\_\_\_\_\_\_\_\_**> week prior to commencing work of this section.
				3. Convene additional meetings minimum [**one**] <**\_\_\_\_\_\_\_\_**> week prior to commencing the following:

Installer performed tests.

System verification tests.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Requirements for transporting, handling, storing, and protecting products.
				2. Accept equipment on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
				3. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
				4. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
			2. WARRANTY

This article extends warranty period beyond one year. Extended warranties increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.

* + - * 1. Requirements for warranties.
				2. Furnish [**five**] <**\_\_\_\_\_\_\_\_**> year manufacturer warranty for pumps, compressors, refrigerated dryers and valves excluding packing.
			1. MAINTENANCE SERVICE
				1. Requirements for maintenance service.

Evaluate need for maintenance and emergency service based Project requirements. If desired, retain the following two paragraphs.

* + - * 1. Furnish service and maintenance of [**equipment**] [**system**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**> for [**one**] <**\_\_\_\_\_\_\_\_**> year from Date of Substantial Completion.
				2. Examine [**equipment**] [**system**] components [**weekly.**] [**semi-monthly.**] [**monthly.**] [**bi-monthly.**] [**Clean, adjust, and lubricate equipment.**]
				3. Calibrate dewpoint alarms [**semi-monthly.**] [**monthly.**] [**bi-monthly.**]
				4. Include systematic examination, adjustment, and lubrication of [**equipment.**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**> Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
				5. Perform work without removing [**equipment**] [**system or components**] from service [**during building normal occupied hours.**] [**between the hours of <\_\_\_\_\_\_\_\_> and <\_\_\_\_\_\_\_\_>.**] [**during maintenance period scheduled in advance with Director’s Representative.**]
				6. Provide emergency call back service [**at all hours**] [**during working hours**] for this maintenance period.
				7. Maintain locally, near Project location, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
				8. Perform maintenance work using competent and qualified personnel under supervision [**and in direct employ**] of manufacturer or original installer.
				9. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of [**Director’s Representative.**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**>
			1. EXTRA MATERIALS
				1. Requirements for extra materials.
				2. Furnish [**one**] <**\_\_\_\_\_\_\_\_**> additional [**dewpoint monitor**] <**\_\_\_\_\_\_\_\_**>.
				3. Furnish [**two**] <**\_\_\_\_\_\_\_\_**> of each [**[prefilter] [final filter] [inlet filter] [exhaust filter] cartridge**] <**\_\_\_\_\_\_\_\_**>.
				4. Furnish [**two**] <**\_\_\_\_\_\_\_\_**> of each [**spring,**] [**poppet,**] [**and**] [**O-ring**] <**\_\_\_\_\_\_\_\_**> for each [**type of medical gas outlet**] <**\_\_\_\_\_\_\_\_**>.
1. PRODUCTS

ASTM B819 specifies type of pipe markings for different services and types. For instance, medical gas piping is identified with manufacturer's markings for oxygen (OXY), medical (MED), oxygen/medical (OXY/MED), oxygen/ACR. Type L pipe has blue markings. Type K has green.

* + - 1. LEVEL 1 AND 2 POSITIVE PRESSURE MEDICAL GAS SYSTEM PIPING
				1. Piping All Sizes, Below Gage Pressure of 185 psig:

Copper Tubing: ASTM B819 (Standard Specification for Seamless Copper Tube for Medical Gas Systems), Type L. Furnish piping identified with manufacturer's markings.

* + - * 1. Piping 2-1/2 inches and Smaller, Above Gage Pressure of 185 psi:

Copper Tubing: ASTM B819 (Standard Specification for Seamless Copper Tube for Medical Gas Systems), Type L. Furnish piping identified with manufacturer's markings.

* + - * 1. Piping 3 inches and Larger, Above Gage Pressure of 185 psi:

Copper Tubing: ASTM B819 (Standard Specification for Seamless Copper Tube for Medical Gas Systems), Type K. Furnish piping identified with manufacturer's markings.

* + - * 1. Fittings: ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze or MSS SP 73 (Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings) wrought and cast copper.
				2. Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.
			1. LEVEL 1 AND 2 MEDICAL-SURGICAL VACUUM SYSTEM PIPING
				1. Copper Tubing: [**ASTM B819**] [**ASTM B88, Type [K,] [L,] [M,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings) cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

The following is proprietary fitting method; delete or edit for project conditions.

Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. AIR COMPRESSOR INTAKE PIPING
				1. Copper Tubing: [**ASTM B819**] [**ASTM B88, Type [K,] [L,] [M,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings) cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. VACUUM PUMP EXHAUST PIPING
				1. Copper Tubing: [**ASTM B819**] [**ASTM B88, Type [K,] [L,] [M,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings) cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. WASTE ANESTHETIC GAS DISPOSAL (WAGD) PIPING
				1. Copper Tubing: [**ASTM B819**] [**ASTM B88, Type [K,] [L,] [M,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings) cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. WAGD PUMP EXHAUST PIPING
				1. Copper Tubing: [**ASTM B819**] [**ASTM B88, Type [K,] [L,] [M,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings) cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. LEVEL 1 AND 2 UNDERGROUND PROTECTOR PIPING
				1. PVC Pipe: ASTM D1785 (Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120), Schedule [**40,**] [**80,**] polyvinyl chloride (PVC) material.

Fittings: [**ASTM D2466, Schedule 40, PVC**] [**ASTM D2467, Schedule 80, PVC**] Use only long radius elbows.

Joints: ASTM D2855 (Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings), solvent weld with ASTM D2564 (Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems) solvent cement.

* + - 1. LEVEL 3 POSITIVE PRESSURE MEDICAL GAS PIPING, ABOVEGROUND
				1. Copper Tubing: ASTM B819 (Standard Specification for Seamless Copper Tube for Medical Gas Systems), Type [**L**] [**K**]. Furnish piping identified with manufacturer's markings.

Fittings: ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze or MSS SP 73 (Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings) wrought and cast copper.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. LEVEL 3 PIPING FOR GAS-POWERED DEVICES
				1. Copper Tubing: [**ASTM B819, Type [K] [L]**] [**ASTM B88, Type [K,] [L,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze or MSS SP 73 (Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings) wrought and cast copper.

ASTM B32 permits up to 0.1 percent lead content in solders not classified as containing lead.

Joints: ASTM B32 (Standard Specification for Solder Metal), Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, [**lead free**] solder.

* + - 1. LEVEL 3 POSITIVE PRESSURE MEDICAL GAS PIPING, BURIED
				1. Copper Tubing: ASTM B819 (Standard Specification for Seamless Copper Tube for Medical Gas Systems), Type [**L**] [**K**]. Furnish piping identified with manufacturer's markings.

Fittings: ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze or MSS SP 73 (Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings) wrought and cast copper.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. LEVEL 3 MEDICAL-SURGICAL VACUUM PIPING
				1. Copper Tubing: [**ASTM B819, Type [K] [L]**] [**ASTM B88, Type [K,] [L,] [M,] drawn**] [**ASTM B280, drawn**].

Fittings: ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze or MSS SP 73 (Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings) wrought and cast copper.

The following is proprietary fitting method; delete or edit for project conditions.

Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

ASTM B32 permits up to 0.1 percent lead content in solders not classified as containing lead.

Joints: ASTM B32 (Standard Specification for Solder Metal), Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, [**lead free**] solder.

* + - * 1. PVC Pipe: ASTM D1785 (Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120), PVC Schedule 40.

Fittings: ASTM D 2466, PVC long radius or wye type.

Joints: ASTM D2855 (Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings), solvent weld with ASTM D2564 (Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems) solvent cement.

* + - * 1. PVC Pipe: ASTM D1785 (Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120), Schedule 80.

Fittings: ASTM D2467 (Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80), PVC long radius or wye type.

Joints: ASTM D2855 (Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings), solvent weld with ASTM D2564 (Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems) solvent cement.

* + - 1. MEDICAL AIR COMPRESSOR SERVICE OR SEAL WATER PIPING
				1. Copper Tubing: ASTM B88 (Standard Specification for Seamless Copper Water Tube), Type [**M,**] [**L,**] [**K,**] drawn.

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings), cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

ASTM B32 permits up to 0.1 percent lead content in solders not classified as containing lead.

Joints: [**ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, [lead free] solder**] [**AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.**]

* + - * 1. Copper Tubing: ASTM B88 (Standard Specification for Seamless Copper Water Tube), Type [**M,**] [**L,**] [**K,**] drawn, rolled grooved ends.

Fittings: [**ASME B16.18 cast copper alloy,**] [**or**] [**ASME B16.22 wrought copper and bronze,**] [**or**] [**ASTM B584 bronze sand castings,**] grooved ends.

Joints: Grooved mechanical couplings meeting ASTM F1476 (Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications).

Housing Clamps: ASTM A395 (Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures) and ASTM A536 (Standard Specification for Ductile Iron Castings) ductile iron, enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.

Gasket: Elastomer composition for operating temperature range from [**-30**] [**86**] <**\_\_\_\_\_\_\_\_**> degrees F to [**230**] [**180**] <**\_\_\_\_\_\_\_\_**>degrees F.

Accessories: [**Steel**] [**Stainless steel**] bolts, nuts, and washers.

* + - 1. MEDICAL VACUUM PUMP SEAL WATER PIPING
				1. Copper Tubing: ASTM B88 (Standard Specification for Seamless Copper Water Tube), Type [**M,**] [**L,**] [**K,**] drawn.

Fittings: ASME B16.18 (Cast Copper Alloy Solder Joint Pressure Fittings), cast copper alloy or ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze.

ASTM B32 permits up to 0.1 percent lead content in solders not classified as containing lead.

Joints: [**ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, [lead free] solder**] [**AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.**]

* + - * 1. Copper Tubing: ASTM B88 (Standard Specification for Seamless Copper Water Tube), Type [**M,**] [**L,**] [**K,**] drawn, rolled grooved ends.

Fittings: [**ASME B16.18 cast copper alloy,**] [**or**] [**ASME B16.22 wrought copper and bronze,**] [**or**] [**ASTM B584 bronze sand castings,**] grooved ends.

Joints: Grooved mechanical couplings meeting ASTM F1476 (Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications).

Housing Clamps: ASTM A395 (Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures) and ASTM A536 (Standard Specification for Ductile Iron Castings) ductile iron, enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.

Gasket: Elastomer composition for operating temperature range from [**-30**] [**86**] <**\_\_\_\_\_\_\_\_**> degrees F to [**230**] [**180**] <**\_\_\_\_\_\_\_\_**>degrees F.

Accessories: [**Steel**] [**Stainless steel**] bolts, nuts, and washers.

* + - 1. RELIEF VALVE VENT PIPING
				1. Copper Tubing: ASTM B819 (Standard Specification for Seamless Copper Tube for Medical Gas Systems), Type [**L**] [**K**]. Furnish piping identified with manufacturer's markings.

Fittings: ASME B16.22 (Wrought Copper and Copper Alloy Solder Joint Pressure Fittings), wrought copper and bronze or MSS SP 73 (Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings) wrought and cast copper.

Joints: Braze, AWS A5.8 (Specification for Filler Metals for Brazing and Braze Welding) BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

* + - 1. UNIONS AND FLANGES
				1. Unions for Pipe 2 inches and Smaller:

Copper Piping: Class 150, bronze unions with [**soldered**] [**brazed joints**].

Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PVC Piping: PVC.

* + - * 1. Flanges for Pipe 2-1/2 inches and Larger:

Copper Piping: Class 150, slip-on bronze flanges.

PVC Piping: PVC flanges.

Gaskets: 1/16 inch thick preformed neoprene gaskets.

* + - * 1. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464 (Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80), Schedule 80, threaded, PVC pipe.
			1. BALL VALVES

In this paragraph, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8855&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Conbroco (Apollo)

Milwaukee

Nibco

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

The following is 3-piece repairable ball valve with extensions. NFPA 99 requires its use on Level 1 and Level 2 positive pressure services.

* + - * 1. [**BA-1**] 2 inches and Smaller: MSS SP 110 (Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends), 600 psi non-shock working pressure, bronze, three piece body, chrome plated bronze ball, full port, teflon seats, blow-out proof stem, solder ends with extensions for brazing, [**lever handle**] [**locking lever handle**] [**extended lever handle**].

Furnish valves cleaned for oxygen service in accordance with CGA G-4.1 (Cleaning Equipment for Oxygen Service) by manufacturer and labeled, sealed, and packed for shipping.

The following is 3-piece ball valve without extensions and requirement for cleaning.

* + - * 1. [**BA-2**] 2 inches and Smaller: MSS SP 110 (Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends), [**Class 150**] <**\_\_\_\_\_\_\_\_**>, bronze, three piece body, [**chrome plated bronze**] [**type 316 stainless steel**] ball, [**regular**] [**full**] port, teflon seats, blow-out proof stem, [**solder**] [**or**] [**threaded**] ends, [**lever handle**] [**wing or tee handle**] [**locking lever handle**] [**extended lever handle**] [**round handle**] [**oval handle**] [**with balancing stops**].

The following is 2-piece ball valve without extensions and requirement for cleaning.

* + - * 1. [**BA-3**] 2 inches and Smaller: MSS SP 110 (Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends), [**Class 150**] <**\_\_\_\_\_\_\_\_**>, bronze, two piece body, [**chrome plated bronze**] [**type 316 stainless steel**] ball, [**regular**] [**full**] port, teflon seats, blow-out proof stem, [**solder**] [**or**] [**threaded**] ends [**with union**], [**lever handle**] [**wing or tee handle**] [**locking lever handle**] [**extended lever handle**] [**round handle**] [**oval handle**] [**with balancing stops**].

The following is ball valve with PVC body and trim.

* + - * 1. [**BA-4**] 2 inches and Smaller: 150 psi at 73 degrees F water temperature, maximum service temperature: 140 degrees F ASTM D1785 (Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120) PVC body and ball, double lever handle, [**EPDM**] [**fluorocarbon**] seals, teflon seats, [**regular**] [**full**] port, [**single**] [**double**] union type with [**socket**] [**threaded**] ends.
				2. Locks: Furnish padlock with keyway matching [**existing keying system.**] [**cylinders specified in Section 087100.**]
			1. BUTTERFLY VALVES

In this paragraph, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=7947&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Milwaukee

Nibco

WATTS

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

Verify compatibility of disc material with vacuum service.

* + - * 1. [**BF-1**] 2-1/2 inches and Larger: MSS SP 67 (Butterfly Valves), [**Class 150**] [**Class 200**] [**Class 250**] <**\_\_\_\_\_\_\_\_**>.

Body: Cast or ductile iron, [**wafer**] [**lug**] [**or**] [**grooved**] ends, stainless steel stem, extended neck.

Disc: [**Nickel-plated ductile iron**] [**Aluminum bronze**] [**Elastomer coated ductile iron**] [**Chrome plated ductile iron**] [**or**] [**stainless steel**].

Seat: Resilient replaceable [**EPDM**] [**Buna N**] [**neoprene Viton**].

The following is butterfly valve with PVC body and trim.

* + - * 1. [**BF-2**] 2 inches through 10 inches: 150 psi at 73 degrees F water temperature, maximum service temperature: 140 degrees F, [**one**] [**two**] piece body, ASTM D1785 (Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120) PVC, lug type flange facing, disc encapsulated with EPDM, stainless steel shaft, locking lever handle.
				2. Locks: Furnish padlock with keyway matching [**existing keying system.**] [**cylinders specified in Section 087100.**]
			1. PIPE HANGERS AND SUPPORTS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=7949&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

McMaster-Carr

Metraflex Co.

Panther Industries

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

NFPA 99 references MSS SP 58 for types of pipe hangers. This standard establishes the material, design, fabrication and inspection criteria to be used in the manufacture of standard types of pipe hanger components.

* + - * 1. Conform to MSS SP 58 (Pipe Hangers and Supports - Materials, Design and Manufacturer).
				2. Furnish hangers for copper piping system with copper finish and sized for copper pipe.
			1. VALVE CABINETS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8854&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Larsen’s Manufacturing Co.

R.P. Crawford Co.

Steven Brown & Associates, Inc.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Valve Cabinets: [**Extruded aluminum**] [**Stainless steel**] [**Galvanized sheet steel**], flush-mounted and rigidly assembled to accommodate valves and fittings, punched or drilled sides to receive tubing, anchors to secure to wall construction.

Size: Sized to accommodate [**single or multiple valves**] [**number of valves indicated on Drawings**].

Cover Plates: [**Extruded aluminum**] [**Stainless steel**] [**Galvanized sheet steel**], with replaceable plastic windows with pull ring to remove window.

Cabinet Labels: Labeled and color coded for intended service and area served in accordance with NFPA 99 (Health Care Facilities).

Valves: Furnish with medical gas valve types as specified in this section. Extensions furnished with gage port on outlet side of valve.

Gages: Furnish [**1-1/2**] <**\_\_\_\_\_\_\_\_**> inch diameter pressure gauge.

Range for Oxygen, Air and Nitrous Oxide: 0 to 100 psig.

Range for Nitrogen: 0 to 300 psig.

Range for Vacuum and WAGD: 0 to 30 inches Hg.

* + - 1. FLEXIBLE PIPE CONNECTORS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=7929&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Engineered Flexible Products

Flexicraft Industries

Metraflex Co.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. 3 inches and Smaller: Corrugated [**bronze**] [**stainless steel**] hose with single layer of [**bronze**] [**stainless steel**] exterior braiding, [**Schedule [40] [80] black steel**] [**copper tubing**] ends; maximum working pressure [**170**] [**190**] <**\_\_\_\_\_\_\_\_**> psig, threaded or soldered ends. Minimum burst pressure of 1000 psi.

Furnish cleaned for oxygen service by manufacturer and labeled, sealed, and packed for shipping.

* + - 1. PRESSURE GAGES

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8120&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Ametek, U.S. Gauge Div.

Ashcroft Dresser Industries Instrument Div.

Weiss Instruments, Inc

Weksler Instruments Corp.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Gage: ASME B40.1 (Gauges - Pressure Indicating Dial Type - Elastic Element) with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

Case: [**Steel**] [**Cast aluminum**] [**Fiberglass reinforced polypropylene**] [**Stainless steel**] [**ABS**].

Bourdon Tube: [**Brass**] [**Phosphor bronze**] [**Type 316 stainless steel**].

Dial Size: [**2 inch**] [**2-1/2 inch**] [**3-1/2 inch**] [**4 inch**] [**4-1/2 inch**] [**6 inch**] [**8-1/2 inch**] diameter.

Mid-Scale Accuracy: [**One**] [**1/2**] <**\_\_\_\_\_\_\_\_**> percent of full scale at point of reading.

Edit the following paragraphs based on whether gages are used for positive pressure or vacuum applications.

Edit based on types of gases included in project.

Use last choice in the following paragraph for non-standard pressure gases and complete applicable pressure ranges.

Scale Range Positive Pressure: [**Normal reading falls within middle 50 percent of scale.**]

Oxygen, Medical Air and Nitrous Oxide: 0 to 100 psig.

Nitrogen: 0 to 300 psig.

Instrument Air: 0 to 300 psig.

<**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**>: <**\_\_\_\_\_\_\_\_**> to <**\_\_\_\_\_\_\_\_**> psig.

Scale Range [**Vacuum**] [**and**] [**Waste Anesthetic Gas Disposal**]: 0 to 29.9 inches Hg.

Scale: [**[Both psi and kPa] [psi] [kPa]**] [**[Both inches and mm] [inches] [mm]**].

Furnish gages with demand check fitting.

Furnish gages cleaned for oxygen service by manufacturer and labeled, sealed, and packed for shipping.

* + - 1. DEW POINT MONITOR

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8119&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Defelsko

Wohler

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Dew Point Monitor:

Continuous dew point readout.

Digital liquid crystal display.

Voltage: 120 volt, single phase, 60 hertz.

Adjustable alarm set point.

Form C alarm relay.

Dry contact for remote indication.

* + - * 1. Accuracy: Plus or minus 0.5 degree F.

Use first choice below for refrigerated air dryers. Use second for desiccant dryers.

* + - * 1. Dew Point Ranges: [**10 degrees F to 70 degrees F**] [**minus 40 degrees F to 15 degrees F**].
			1. CARBON MONOXIDE MONITOR

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8118&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

MST, Inc.

PCE Americans, Inc.

AMETEK Process Instruments

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Carbon Monoxide Monitor:

Continuous carbon monoxide readout.

Digital liquid crystal display.

Voltage: 120 volt, single phase, 60 hertz.

Adjustable alarm set point.

Automatic calibration.

Dry contact for remote indication.

Visual and audible alarm.

* + - * 1. Accuracy: 1 part per million.
				2. Calibration Kit: Furnish with gas valve, and connector with 20 ppm carbon monoxide test gas.
			1. MEDICAL GAS OUTLETS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8117&mf=04&src=wd): 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

Allied Healthcare Products

Ohio Medical

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

Verify type of outlets used in facility. Each type of outlet is not compatible with other types. Indicate by manufactured type.

* + - * 1. Style: [**Diameter Index Safety System (DISS) in accordance with CGA V-5**] [**Chemetron compatible**] [**Puritan-Bennett compatible**] [**MEDAES/Ohmeda compatible**].

DISS type for outlets are usually used for ceiling mounting. Nitrogen outlets are always DISS type.

* + - * 1. Location: [**Wall**] [**Console**] [**Ceiling**] [**Ceiling Column**] [**Surface Console**] [**Dental**].
				2. Mounting: [**Flush, recessed.**] [**Surface.**] <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**>
				3. Furnish outlets with the following features:

Non-interchangeable connectors, automatic valves, secondary check valves (except vacuum and evacuation outlets), and capped 3/8 inch tubing stubs for supply connections, color coded and labeled for intended service.

Latch mechanisms designed for one handed, single thrust mounting and one handed fingertip release of secondary equipment.

Furnish outlets cleaned for oxygen service by manufacturer and labeled, sealed, and packed for shipping.

* + - * 1. Face Plates:

Flush Outlets: Mount in galvanized steel boxes with [**stainless steel**] [**chrome-plated**] faceplate with Lexan cover, color coded with embossed labeling.

Surface Outlets: Surface mount with color-coded plastic cover and [**stainless steel**] [**chrome-plated**] faceplate with Lexan cover, color-coded with embossed labeling.

* + - * 1. Vacuum Bottle Brackets: Stainless steel, chrome-plated metal, or aluminum with finish matching adjacent outlet.

The following portion of this section allows specification of medical air compressor source system, medical vacuum pump source system, instrument air source system, and waste anesthetic gas disposal source without duplicating specifications for system components.

When project includes packaged assemblies use the applicable source system Article. When renovating existing system use individual component specifications.

Edit applicable source system specification to include features and components applicable to project. Retain specifications for various components listed after source system specifications. Retain manufacturer's names only for the source system specification.

* + - 1. MEDICAL AIR COMPRESSOR SOURCE SYSTEM

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8116&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Allied Healthcare Products, Inc.; Chemetron Div.

Jun-Air USA, Inc.

Puritan-Bennett Corp.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Medical Air Compressor Source System: Packaged assembly factory wired, factory piped, with components mounted on common base and single point connections for electrical, intake air, discharge air, and condensate drains.

Isolate system components with valves to allow service to each component without interrupting medical air supply.

Edit the following to meet project conditions. Also edit based on manufacturer chosen as basis for design. Not every manufacturer offers configurations listed.

* + - * 1. System Components:

Make choices in the following paragraph based on defined level of facility for either duplex or simplex and based on desired compressor technology.

Medical Air Compressor: [**Duplex,**] [**Simplex**] [**rotary, oil free, liquid ring**] [**reciprocating, oil less**] [**scroll**], motor driven. Furnish each compressor sized for rated system capacity.

Control panel.

Air intake filter.

Receiver: Furnished with 3 valve bypass.

Evaluate type of medical air dryer to be used in medical compressed air systems. Current NFPA requirements may preclude use of refrigerated air dryers.

Refrigerated Air Dryer: [**Refrigerated cycling type.**] [**Refrigerated non-cycling type.**] Furnish [**two dryers**] [**single dryer**] piped in parallel arrangement each sized for rated system capacity. Capable of producing air at maximum dew point below frost point of 32 degrees F at any level of demand.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Desiccant Air Dryer: Furnish [**two dryers**] [**single dryer**] piped in bypass arrangement each sized for rated system capacity. Capable of producing -40 degrees F pressure dew point at any level of demand.

Pressure Regulating Valve: Furnish two pressure regulating valves piped in parallel arrangement each sized to pass rated system capacity.

Compressed Air Filter: Furnish two final filters piped in parallel arrangement each sized to pass rated system capacity.

Dew Point Monitor. Furnish with demand check valve.

Carbon Dioxide Monitor. Furnish with demand check valve.

Source Valve.

Relief valve.

Pressure gage with demand check valve.

System pressure switch or sensor with demand check valve.

Flexible intake connector.

Flexible discharge connector.

Flexible seal water connector.

* + - * 1. Control Panel: UL listed [**duplex**] <**\_\_\_\_\_\_\_\_**> electrical control system mounted in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure. Lag compressor is able to start automatically when lead compressor fails to operate. Including the following:

Magnetic motor starter for each compressor.

Automatic lead compressor alternator.

Hand-Off-Automatic selector switches mounted in cabinet cover.

Dual redundant control circuit transformers.

Externally operable fusible disconnect with door interlock.

Run time hour meter for each compressor.

Compressor running light.

Minimum run timer to prevent short cycle operation.

Panel mounted pressure gauge.

Dryers controlled from main control panel with selector switches mounted on control panel.

Control Panel Display: Furnish audible and visual local alarm complete with indicating lights and individual sets of auxiliary contacts wired to the terminal strip for remote alarm indication for the following:

Compressor run lights.

Lag compressor operation.

High separator water level.

High receiver water level.

Compressor temperature malfunction.

Reserve compressor in use.

Manual reset for thermal malfunction shut-down.

* + - * 1. Capacity:

Compressor Capacity: <**\_\_\_\_\_\_\_\_**> scfm at <**\_\_\_\_\_\_\_\_**> psi.

Compressor Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

Receiver:

Diameter: <**\_\_\_\_\_\_\_\_**> inches.

[**Height**] [**Length**]: <**\_\_\_\_\_\_\_\_**> inches.

Volume: <**\_\_\_\_\_\_\_\_**> gallons.

Air Dryer Capacity:

Discharge Air: <**\_\_\_\_\_\_\_\_**> degrees F atmospheric dew point.

Rated Air Flow: <**\_\_\_\_\_\_\_\_**> scfm.

Inlet Air Pressure: <**\_\_\_\_\_\_\_\_**> psi.

Pressure Differential from Inlet to Outlet: Maximum <**\_\_\_\_\_\_\_\_**> psi.

Air Dryer Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

* + - 1. MEDICAL VACUUM PUMP SOURCE SYSTEM

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8115&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Gast Manufacturing Corp.

Kinney Vacuum Co.

Thomas Industries, Inc.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Medical Vacuum Pump Source System: Packaged assembly factory wired, factory piped, with components mounted on common base and single point connections for electrical, intake air, discharge air, and condensate drains.

Isolate components with valves to allow service to each component without interrupting vacuum system operation.

* + - * 1. System Components:

Make choices in the following paragraph based on defined level of facility for either duplex or simplex and based on desired vacuum pump technology.

Vacuum Pump: [**Duplex**] [**Simplex**], [**rotary liquid ring**] [**lubricated rotary vane**] [**oil less rotary vane**] [**dynamic principle**], motor driven. Furnish each vacuum pump sized for rated system capacity.

Control panel.

Discharge muffler.

Receiver. Furnished with 3 valve bypass.

Source valve.

Vacuum indicator.

System vacuum switch or sensor.

Flexible intake connector.

Flexible discharge connector.

Flexible water connector.

* + - * 1. Control Panel: UL listed [**duplex**] <**\_\_\_\_\_\_\_\_**> electrical control system mounted in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure. Lag vacuum pump is able to start automatically when lead vacuum pump fails to operate. Including the following:

Magnetic motor starter for each vacuum pump.

Automatic lead vacuum pump alternator.

Hand-Off-Auto selector switches.

Dual redundant control circuit transformers.

Externally operable fusible disconnect with door interlock.

Run time hour meter for each vacuum pump.

Motor running light.

Minimum run timer to prevent short cycle operation.

Control Panel Display: Furnish audible and visual local alarm complete with indicating lights and individual sets of auxiliary contacts wired to the terminal strip for remote alarm indication for the following:

Vacuum pump thermal malfunction.

Reserve vacuum pump in use.

* + - * 1. Capacity:

Vacuum Pump Capacity: <**\_\_\_\_\_\_\_\_**> cfm expanded air at <**\_\_\_\_\_\_\_\_**> psi, capable of producing maximum vacuum of <**\_\_\_\_\_\_\_\_**> inches Hg.

Vacuum Pump Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

Receiver:

Diameter: <**\_\_\_\_\_\_\_\_**> inches.

[**Height**] [**Length**]: <**\_\_\_\_\_\_\_\_**> inches.

Volume: <**\_\_\_\_\_\_\_\_**> gallons.

* + - 1. INSTRUMENT AIR SOURCE SYSTEM

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8114&mf=04&src=wd): 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

Beacon Medaes

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Instrument Air Source System: Packaged assembly factory wired, factory piped, with components mounted on common base and single point connections for electrical, intake air, discharge air, and condensate drains.

Isolate components with valves to allow service to each component without interrupting instrument air supply.

When providing full duplex plant, use the following paragraph. When providing plant with cylinder backup, use second paragraph.

* + - * 1. Duplex System: Furnish system consisting of duplex compressors, receiver, duplex air treatment systems and controls capable of providing scheduled capacity with one compressor out of service.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Cylinder Backup: Furnish system consisting of one compressor, receiver, simplex air treatment system, backup manifold for at least one hour's operation and controls.
				2. System Components:

Air Compressor: [**Duplex**] [**Simplex**] <**\_\_\_\_\_\_\_\_**>, motor driven, oil less, multi-stage, air cooled, reciprocating type air compressors capable of 200 psig minimum. Furnish each compressor with an after cooler with approach temperature of not greater than 12 degrees F.

Control panel.

Air intake filter.

Receiver: Furnished with 3 valve bypass.

Desiccant Air Dryer: Furnish [**two dryers**] [**single dryer**] piped in bypass arrangement each sized for rated system capacity. Capable of producing -40 degrees F pressure dew point.

Pressure Regulating Valve: Furnish [**two**] [**single**] pressure regulating valves piped in bypass arrangement each sized to pass rated system capacity.

Compressed Air Filter: Furnish [**two**] [**single**] final filters piped in bypass arrangement each sized to pass rated system capacity.

Dew Point Monitor. Furnish with demand check valve.

Source Valve.

Relief valve.

Pressure gage with demand check valve.

System pressure switch or sensor with demand check valve.

Flexible intake connector.

Flexible discharge connector.

* + - * 1. Control Panel: UL listed [**duplex**] <**\_\_\_\_\_\_\_\_**> electrical control system mounted in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure. Lag compressor is able to start automatically when lead compressor fails to operate. Including the following:

Magnetic motor starter for each compressor.

Retain the following for duplex systems.

Automatic lead compressor alternator.

Hand-Off-Auto selector switches.

Dual redundant control circuit transformers.

Externally operable fusible disconnect with door interlock.

Run time hour meter for each compressor.

Compressor running light.

Minimum run timer to prevent short cycle operation.

Panel mounted pressure gauge.

Dryers controlled from main control panel with selector switches mounted on control panel.

Retain the following for simplex systems with cylinder backup.

Controls to activate reserve manifold when compressor is unable to supply system.

Control Panel Display: Furnish audible and visual local alarm complete with indicating lights and individual sets of auxiliary contacts wired to the terminal strip for remote alarm indication for the following:

Compressor run lights.

Lag compressor operation.

High separator water level.

High receiver water level.

Compressor temperature malfunction.

Reserve compressor in use.

Manual reset for thermal malfunction shut-down.

High discharge air temperature shutdown.

Retain the following when source includes cylinder backup.

* + - * 1. Reserve Cylinder Header: Fitted with CGA V-1 (Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections) medical air connections and connection points for cylinders to allow one hour operation from cylinder supply.
				2. Capacity:

Compressor Capacity: <**\_\_\_\_\_\_\_\_**> scfm at <**\_\_\_\_\_\_\_\_**> psi.

Compressor Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

Receiver:

Diameter: <**\_\_\_\_\_\_\_\_**> inches.

[**Height**] [**Length**]: <**\_\_\_\_\_\_\_\_**> inches.

Volume: <**\_\_\_\_\_\_\_\_**> gallons.

Air Dryer Capacity:

Discharge Air: <**\_\_\_\_\_\_\_\_**> degrees F atmospheric dew point.

Rated Air Flow: <**\_\_\_\_\_\_\_\_**> scfm.

Inlet Air Pressure: <**\_\_\_\_\_\_\_\_**> psi.

Pressure Differential from Inlet to Outlet: Maximum <**\_\_\_\_\_\_\_\_**> psi.

Air Dryer Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

Reserve Cylinder Capacity:

Number of cylinders: <**\_\_\_\_\_\_\_\_**>.

Delivery Rate: <**\_\_\_\_\_\_\_\_**> cfh.

Delivery Pressure: <**\_\_\_\_\_\_\_\_**> psi.

* + - 1. WASTE ANESTHETIC GAS DISPOSAL SOURCE

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8113&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Beacon Medaes

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Waste Anesthetic Gas Disposal Source: Packaged assembly factory wired, factory piped, with components mounted on common base and single point connections for electrical, intake air, discharge air, and condensate drains.

Isolate components with valves to allow service to each component without interrupting WAGD system operation.

* + - * 1. System Components:

Retain the bracketed sentence at end of the following paragraph for liquid ring or oil less rotary vane type pumps.

Make choices in the following paragraph based defined level of facility for either duplex or simplex and based on desired vacuum pump technology.

Vacuum Pump: [**Duplex**] [**Simplex**], [**rotary liquid ring**] [**oil less rotary vane**] [**dynamic principle**], motor driven. Furnish each vacuum pump sized for rated system capacity. [**Provide vacuum regulation to maintain a maximum system vacuum of 5 inches Hg.**]

Control panel.

Discharge muffler.

Receiver. Furnished with 3 valve bypass.

Source valve.

Vacuum indicator.

System vacuum switch or sensor.

Flexible intake connector.

Flexible discharge connector.

Flexible water connector.

* + - * 1. Control Panel: UL listed [**duplex**] <**\_\_\_\_\_\_\_\_**> electrical control system mounted in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure. Lag vacuum pump is able to start automatically when lead vacuum pump fails to operate. Including the following:

Magnetic motor starter for each WAGD pump.

Automatic lead WAGD pump alternator.

Hand-Off-Auto selector switches.

Dual redundant control circuit transformers.

Externally operable fusible disconnect with door interlock.

Runtime hour meter for each producer.

Motor running light.

Minimum run timer to prevent short cycle operation.

Control Panel Display: Furnish audible and visual local alarm complete with indicating lights and individual sets of auxiliary contacts wired to the terminal strip for remote alarm indication for the following:

WAGD pump thermal malfunction.

Reserve WAGD pump in use.

* + - * 1. Capacity:

Vacuum Pump Capacity: <**\_\_\_\_\_\_\_\_**> cfm expanded air at <**\_\_\_\_\_\_\_\_**> psi, capable of producing maximum vacuum of <**\_\_\_\_\_\_\_\_**> inches Hg.

Vacuum Pump Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

Receiver:

Diameter: <**\_\_\_\_\_\_\_\_**> inches.

[**Height**] [**Length**]: <**\_\_\_\_\_\_\_\_**> inches.

Volume: <**\_\_\_\_\_\_\_\_**> gallons.

* + - 1. MEDICAL AIR COMPRESSOR

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8123&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Bauer Processed Air, Inc.

Champion Pneumatic Machinery Co., Inc.

Squire-Cogswell Co.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Rotary Oil Free Liquid Ring Compressors: Single-stage positive displacement, and non-pulsating pumps fitted with mechanical seals.

Construction: Iron with bronze or stainless rotor and carbon steel shaft.

Recirculation and Seal Water: Under normal operation, minimize use of seal water. Furnish reservoir sized for 48 hours operation without water supply. System is self contained.

Components: Dielectric union, anti-syphon valve, strainer, solenoid valve, flow control valve, and orifice union.

Furnish with relief valve, check valve, isolation valve, flexible connector, exhaust muffler, and vibration isolators at each mounting location.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

After coolers may be required for compressors 7-1/2 hp and larger. Edit the following based on compressor motor size.

* + - * 1. Reciprocating Compressor: Single stage, oil less, air cooled, type. Each compressor head furnished with unloader. Maximum compressor rotation speed: 1180 rpm. Crankcase ventilation filtered to prevent dust and insects from entering crankcase.

Construction: Corrosion resistant valves with stainless steel reeds. Crankcase and head constructed of cast iron and fully supported on each end by permanently lubricated and sealed ball bearings.

Piston Pin: Insulated to minimize heat transmission from piston head to connecting rod.

Bearings: Permanently lubricated and sealed.

After Cooler: Furnish compressor with after cooler with approach temperature of not greater than 12 degrees F, moisture separator, and automatic drain valve.

Components: High discharge air temperature shutdown switch wired to each cylinder head, relief valve, check valve, isolation valve, flexible connector, exhaust muffler, and vibration isolators at each mounting location.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Scroll Compressor: Continuous duty rated type with sealed bearings, single stage, air-cooled, consisting of one fixed and one orbiting scroll.

Seals: PTFE tip seals between the scroll halves and rated for 120 psig discharge pressure.

Bearings: Orbiting type grease filled and permanently sealed not requiring lubrication.

Motor Base: Pivoting adjustable type.

After Cooler: Furnish compressor with integral air-cooled after cooler designed for maximum approach temperature of 15 degrees F at 100 degrees F and automatic drain valve.

Discharge Valve: Integral valve located in discharge piping of compressor to provide load-less starting and capable of preventing less than 1/4 revolution of reverse rotation of scroll at shutdown.

Components: Relief valve, check valve, isolation valve, flexible connector, exhaust muffler, and vibration isolators at each mounting location.

Control panel specified below is intended to be included when the air compressor is specified individually. Coordinate with source system specification to not duplicate requirements.

* + - * 1. Control Panel: Factory wired in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure with the following:

Fusible disconnect switches.

Magnetic motor starters with overload protection.

Control circuit transformers.

Run time hour meter.

Automatic water and air by-pass circuits.

Pressure switches.

Hand-off automatic selector switches mounted in cabinet cover.

Externally operable fusible disconnect with door interlock.

* + - * 1. Capacity:

Compressor Capacity: <**\_\_\_\_\_\_\_\_**> scfm at <**\_\_\_\_\_\_\_\_**> psi.

Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

* + - 1. MEDICAL VACUUM PUMP

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8122&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Allied Healthcare Products, Inc.; Chemetron Div.

Gast Manufacturing Corp.

Kinney Vacuum Co.

Thomas Industries, Inc.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Rotary Liquid Ring Pumps: Oil free, single-stage positive displacement, and non-pulsating type. Pump fitted with mechanical seals.

Construction: Iron with bronze or stainless rotor and carbon steel shaft.

Recirculation and Seal Water: Under normal operation, minimize use of seal water. Furnish reservoir sized for 48 hours operation without water supply. System is self contained.

Components: Furnish with check valve to prevent backflow through off cycle units. Furnish each pump with flexible connector, isolation valve, exhaust muffler, and vibration isolators at each mounting location.

Recirculation and Seal Water Components: Dielectric union, anti-syphon valve, strainer, solenoid valve, flow control valve, and orifice union.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Lubricated Rotary Vane Pumps: Oil lubricated, dynamically balanced multi-vane design with aluminum alloy vanes for maximum heat dissipation. Minimum vane life is 50,000 operation hours.

Oil Recirculation: Differential pressure with full recirculation and multi-stage exhaust oil separation rated at not less than 99.998 percent efficiency. Furnish each pump with oil non-return valve, filter change indicator for exhaust oil separation filters, and high discharge temperature switch. Service to oil lubrication system filters does not require disconnection of exhaust piping. Oil lubrication system enclosed in one module to minimize oil leaks. Furnish with non-return valve to prevent oil migration upon shutdown, back pressure gage to indicate exhaust oil separator element change.

Components: High discharge temperature switch, oil drain valve, oil sight glass, flexible connector, isolation valve, and vibration isolators at each mounting location.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Oil Less Rotary Vane Pumps: Completely dry pumps equipped with self-lubricating carbon-graphite vanes. Bearings lubricated and sealed. Oil is not permitted in pump. Each pump air-cooled and has no water requirement.

Inlet Filter: Furnish each pump with 5 micron inlet filter.

Components: Vacuum relief valve, check valve to prevent backflow through off-cycle units, flexible connector, isolation valve, and vibration isolators at each mounting location.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Dynamic Principle Pumps: Multi-stage, regenerative pumps, dynamic principle, employing four stages of compression. Internal construction is friction free with rotor turning freely in housing. Each pump equipped with four bearing points which require lubrication not more often than once annually. Pump is completely dry with no oil or other sealants anywhere in machine. Pump does not have any wearing vanes.

Furnish pumps with high vacuum and high exhaust temperature shutdown and alarms.

Filter: Furnish each pump with 5 micron inlet filter.

Components: Vacuum relief valve, check valve to prevent backflow through off-cycle units, flexible connector, isolation valve, exhaust muffler, and vibration isolators at each mounting location.

Control panel specified below is intended to be included when the air compressor is specified individually. Coordinate with source system specification to not duplicate requirements.

* + - * 1. Electrical Controls: Factory wired in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure, with:

Fusible disconnects.

Magnetic motor starters.

Overload protection with manual reset.

Control circuit transformers.

Automatic alternators.

Vacuum control switches.

Hand-off automatic switches in cabinet cover.

Safety disconnect door.

* + - * 1. Capacity:

Capacity: <**\_\_\_\_\_\_\_\_**> cfm expanded air at <**\_\_\_\_\_\_\_\_**> psi, capable of producing maximum vacuum of <**\_\_\_\_\_\_\_\_**> inches Hg.

Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

* + - 1. ORAL EVACUATION PUMPS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8121&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Pro-Set

Welch

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Oral Evacuation Pump: Multi-stage turbine type with direct connected electric motor drive.
				2. Surge Control and Silencer: Automatic modulating control responding to motor current, bleeds air into turbine when system operates at less than 50 percent capacity, with baffled, sound-absorbent, line muffler.
				3. Separators: Welded galvanized steel with factory applied corrosion preventative lining with float switches, drain pumps, sediment strainers, ball floats, quick opening springs, flushing water supply globe valves, disinfectant funnels and valves, cleanout openings, tangential intakes, and high level float cutout switch.
				4. Receiver: Vertical welded steel ASME Section VIII (Boiler and Pressure Vessel Code - Pressure Vessels) receiver, prime coated with vinyl lining, with gage, safety relief valve, and automatic tank drain.
				5. Capacity:

Evacuation Pump Capacity: <**\_\_\_\_\_\_\_\_**> cfm, capable of producing vacuum of <**\_\_\_\_\_\_\_\_**> inches Hg.

Evacuation Pump Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> hp.

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

Receiver:

Diameter: <**\_\_\_\_\_\_\_\_**> inches.

Height: <**\_\_\_\_\_\_\_\_**> inches.

Volume: <**\_\_\_\_\_\_\_\_**> gallons.

* + - 1. RECEIVER

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8112&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Midwest Tank Company

Steel-Pro Incorporated

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Receiver: [**Vertical**] [**Horizontal**], welded steel construction, built to ASME Section VIII (Boiler and Pressure Vessel Code - Pressure Vessels) regulations for working pressure of [**150**] <**\_\_\_\_\_\_\_\_**> psi. Flange or screw inlet and outlet connections.
				2. Medical Air Receiver Accessories: Pressure relief valve, pressure gage, automatic tank drain, manual tank drain, and sight glass.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Vacuum Receiver Accessories: Manual drain, sight glass, and vacuum gage.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Instrument Air Receiver Accessories: Pressure relief valve, pressure gage, automatic tank drain, manual tank drain, and sight glass.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. WAGD Receiver Accessories: Manual drain, sight glass, and vacuum gage.
				2. Receiver Finish:

Exterior: [**Prime coated**] [**Hot dipped galvanized**].

Interior: Factory applied [**vinyl**] <**\_\_\_\_\_\_\_\_**> lining.

* + - * 1. Capacity:

Diameter: <**\_\_\_\_\_\_\_\_**> inches.

[**Height**] [**Length**]: <**\_\_\_\_\_\_\_\_**> inches.

Volume: <**\_\_\_\_\_\_\_\_**> gallons.

* + - 1. REFRIGERATED AIR DRYER

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8111&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Ingersoll

Speedaire

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Refrigerated Medical Air Dryer: [**Cycling**] [**Non-cycling**] type with self contained mechanical refrigeration complete with heat exchanger, hermetic refrigeration compressor, automatic controls, moisture removal trap, internal wiring and piping, and full refrigerant charge.
				2. Cord and Plug: Furnish unit with [**6**] <**\_\_\_\_\_\_\_\_**> foot cord and plug for connection to electric wiring system [**including grounding connector**].
				3. Gages:

Air inlet temperature gage.

Air inlet pressure gage.

Air outlet temperature gage.

Air outlet pressure gage.

* + - * 1. Accessories:

Refrigerant suction pressure gage.

On-off switch with power on light.

High temperature warning light.

Compressor on light.

Electronic drain.

High dew point temperature light.

* + - * 1. Capacity:

Discharge Air: <**\_\_\_\_\_\_\_\_**> degrees F atmospheric dew point.

Rated Air Flow: <**\_\_\_\_\_\_\_\_**> scfm.

Inlet Air Pressure: <**\_\_\_\_\_\_\_\_**> psi.

Pressure Differential from Inlet to Outlet: Maximum <**\_\_\_\_\_\_\_\_**> psi.

* + - * 1. Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

* + - 1. DESICCANT AIR DRYER

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8110&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Deltech

Parker

Wilkerson

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Desiccant Air Dryer: Self contained, [**single tower**] [**dual tower**] type containing absorbent desiccant, complete with drain connection, and controls.
				2. Operation: Solid state controller automatically switches operation between towers mounted in NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 12 enclosure.
				3. Towers: ASME Section VIII (Boiler and Pressure Vessel Code - Pressure Vessels) designed and constructed pressure vessels. Design Working Pressure: [**150 psig**] [**<\_\_\_\_\_\_\_\_> psig**]. Flange or threaded inlets and outlets.

Edit the following to match options available on dryer and to meet project conditions.

* + - * 1. Accessories:

Automatic float drain valve.

Pre-filter.

After-filter.

Temperature gage mounted on [**each**] tower.

Air inlet pressure gage mounted on [**each**] tower.

Pressure gage mounted on [**each**] tower.

[**Pressure**] [**Safety**] relief valve mounted on [**each**] tower.

Purge control.

Switching failure alarm.

Use moisture separator upstream of dryer with liquid ring air compressors.

* + - * 1. Moisture Separator: Stainless steel construction rated for 3 micron and capable of removing both bulk liquid and large particles. Furnish with element change indicator. Factory mounted and piped with automatic solenoid drain valve.
				2. Capacity:

Discharge Air: <**\_\_\_\_\_\_\_\_**> degrees F pressure dew point at <**\_\_\_\_\_\_\_\_**> psi.

Rated Air Flow: <**\_\_\_\_\_\_\_\_**> scfm.

Pressure Differential from Inlet to Outlet: Maximum <**\_\_\_\_\_\_\_\_**> psi.

* + - * 1. Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

* + - 1. PRESSURE REGULATING VALVE

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8109&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Camco

Emerson

Husky

Rheem Manufacturing

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Pressure Regulating Valve: Self-contained. Bronze body, stainless steel seat, pressure setting adjustment range of 10 to 125 psig.
			1. COMPRESSED AIR FILTERS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8108&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Ingersoll

Campbell Hausfeld

Chicago Pneumatic

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Pre-filter: Coalescing type with efficiency of [**98**] <**\_\_\_\_\_\_\_\_**> percent and [**0.5**] [**1.0**] <**\_\_\_\_\_\_\_\_**> micron particle removal, threaded inlets and outlet connections, and element change indicator.
				2. After-Filter: Coalescing type with efficiency of [**98**] <**\_\_\_\_\_\_\_\_**> percent and [**0.01**] <**\_\_\_\_\_\_\_\_**> micron particle, oil mist, and oil aerosol removal, threaded inlets and outlet connections, and element change indicator. Maximum downstream remaining oil content 0.01 ppm by weight.
				3. Activated Carbon Filter: Activated carbon adsorption type for removal of oil vapor and associated odors. Maximum downstream remaining oil content 0.003 ppm by weight. Furnish continuous visual indicator showing status of filter element.
			1. GAS CYLINDER MANIFOLD

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8107&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Ashcroft, Inc.

Sutton-Garten Co.

Quark Glass, LLC

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Gas: [**Nitrous Oxide**] [**Nitrogen**] [**Medical Air**] [**Oxygen**] [**Carbon Dioxide**].
				2. Duplex Automatic Manifold: Consisting of wall mounted control cabinet, cylinders, header connections, and pigtails for cylinders. Furnish automatic changeover from primary to secondary bank and allow replacing depleted cylinders with no change in line pressure.
				3. By-pass System: Between regulators to service regulator or switch over system without interrupting supply of gas. Pipe bleed valves to vent connector within cabinet to allow adjustment of pressure regulators.
				4. Cabinet: House components in locking cabinet with NEMA 250 (Enclosures for Electrical Equipment (1000 Volts Maximum)) Type 1 enclosure and baked enamel finish.

Three front mounted gages indicate header and line pressures.

[**Green**] <**\_\_\_\_\_\_\_\_**> indicator light indicates service bank in use.

[**Amber**] <**\_\_\_\_\_\_\_\_**> indicator light indicates bank ready.

[**Red**] <**\_\_\_\_\_\_\_\_**> indicator light indicates reserve bank in use or bank empty.

Furnish pressure switches to activate signals.

Furnish terminal block connections for remote alarms.

* + - * 1. Cylinder Capacity: Total of <**\_\_\_\_\_\_\_\_**> cylinders arranged for <**\_\_\_\_\_\_\_\_**> cylinders in service and <**\_\_\_\_\_\_\_\_**> cylinders in reserve.
				2. [**Nitrous Oxide**] [**Nitrogen**] [**Medical Air**] [**Oxygen**] [**Carbon Dioxide**] Manifold Delivery: Maximum <**\_\_\_\_\_\_\_\_**> cfh continuously at [**50**] [**180**] <**\_\_\_\_\_\_\_\_**> psi.
				3. Pressure Regulators: Furnish duplex pressure regulators installed in parallel with shutoff valves before each regulator and shutoff or check valve after each regulator.
				4. Pressure Gages: Furnish located downstream of pressure regulator or shutoff valve.
				5. Relief Valve: [**Brass**] [**Bronze**] [**Stainless steel**] body, seat and trim compatible with gas service, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.
				6. Electrical Characteristics:

<**\_\_\_\_\_\_\_\_**> volts, [**single**] [**three**] phase, 60 Hz.

<**\_\_\_\_\_\_\_\_**> amperes maximum [**fuse size**] [**circuit breaker size**] [**overcurrent protection**].

* + - 1. AREA ALARM PANEL

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8106&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Allied Healthcare Products, Inc.; Chemetron Div.

BACONMEDAES, Inc.

Puritan-Bennett Corp.

Approved equivalent.

* + - * 1. Substitutions: [**Section 016000 - Product Requirements**] [**Not permitted**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Area Alarm Panels: Modular, self-monitoring type, to monitor the following services: [**oxygen,**] [**vacuum,**] [**nitrous oxide,**] [**nitrogen,**] [**medical air,**] [**instrument air**] [**and**] [**carbon dioxide**].

Green light for systems normal.

High or low pressure warning:

Green light extinguishes.

Audible warning device sounds.

Red light energizes.

Gage indicates pressure or vacuum.

Switch silences warning device.

Test switch to test light bulbs and audible warning device.

Furnish system with internal switches, gages, control unit, and transformer.

The following list was taken from NFPA 99 Annex. Edit list based on types of services to area alarm panel. Items 1 and 2 could be copied and edited to list each gas.

* + - * 1. Monitor the following abnormal conditions:

High line pressure (for each medical gas).

Low line pressure (for each medical gas).

Low medical-surgical vacuum.

Low WAGD vacuum.

Backup medical air compressor in operation.

Backup vacuum pump in operation.

Backup WAGD producer in operation.

Backup instrument air [**compressor**] [**cylinder**] in operation.

Medical air system carbon monoxide concentration high.

Medical air system high discharge air temperature.

Medical air system high water level in [**receiver**] [**separator**].

Medical air system high dew point.

Instrument air system high dew point.

* + - 1. MASTER ALARM PANEL

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8105&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Allied Healthcare Products, Inc.; Chemetron Div.

BACONMEDAES, Inc.

Puritan-Bennett Corp.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Master Alarm Panel:

Closed circuit, self-monitoring type, to monitor medical gas systems.

Green light for systems normal.

For abnormal condition:

Green light extinguishes.

Audible warning device sounds.

Red light energizes.

Gage indicates pressure or vacuum.

Switch silences warning device.

Test switch to test light bulbs and audible warning device.

Furnish system with internal switches, gages, control unit, and transformer.

Design system to allow one, two or more monitors capable of being connected to single pressure switch.

* + - * 1. Monitor the following source (remote) conditions:

Nitrogen Cylinder Supply:

Nitrogen Main Line Pressure High.

Nitrogen changeover to secondary supply.

Carbon Dioxide Cylinder Supply:

Carbon Dioxide Main Line Pressure High.

Carbon Dioxide Main Line Pressure Low.

Carbon Dioxide Changeover to Secondary Supply.

Medical Air Cylinder Supply:

Medical Air Main Line Pressure High.

Medical Air Main Line Pressure Low.

Medical Air Changeover to Secondary Supply.

Medical Air Dew Point High.

Oxygen Cylinder Supply:

Oxygen Main Line Pressure High.

Oxygen Main Line Pressure Low.

Oxygen Changeover to Secondary Supply.

Oxygen Cryogenic Liquid Cylinders with Reserve:

Oxygen Main Line Pressure High.

Oxygen Main Line Pressure Low.

Oxygen Changeover to Secondary Supply.

Oxygen Reserve in use.

Oxygen Reserve Supply Low Contents.

Oxygen Cryogenic Bulk with Cryogenic Reserve:

Oxygen Main Line Pressure High.

Oxygen Main Line Pressure Low.

Oxygen Changeover to Secondary Supply.

Oxygen Main Supply Low Contents.

Oxygen Reserve in Use.

Oxygen Reserve Supply Low Contents.

Oxygen Reserve Pressure Low.

Oxygen Cryogenic Bulk with Cylinder Reserve:

Oxygen Main Line Pressure High.

Oxygen Main Line Pressure Low.

Oxygen Changeover to Secondary Supply.

Oxygen Main Supply Low Contents.

Oxygen Reserve in Use.

Nitrous Oxide Cylinder Supply:

Nitrous Oxide Main Line Pressure High.

Nitrous Oxide Main Line Pressure Low.

Nitrous Oxide Changeover to Secondary Supply.

Nitrous Oxide Cryogenic Liquid Cylinders with Reserve:

Nitrous Oxide Main Line Pressure High.

Nitrous Oxide Main Line Pressure Low.

Nitrous Oxide Changeover to Secondary Supply.

Nitrous Oxide Reserve in Use.

Nitrous Oxide Reserve Supply Low Contents.

Nitrous Oxide Cryogenic Bulk with Cryogenic Reserve:

Nitrous Oxide Main Line Pressure High.

Nitrous Oxide Main Line Pressure Low.

Nitrous Oxide Changeover to Secondary Supply.

Nitrous Oxide Main Supply Low Contents.

Nitrous Oxide Reserve in Use.

Nitrous Oxide Reserve Supply Low Contents.

Nitrous Oxide Reserve Pressure Low.

Nitrous Oxide Cryogenic Bulk with Cylinder Reserve:

Nitrous Oxide Main Line Pressure High.

Nitrous Oxide Main Line Pressure Low.

Nitrous Oxide Changeover to Secondary Supply.

Nitrous Oxide Main Supply Low Contents.

Nitrous Oxide Reserve in Use.

Medical Air Compressor Source System:

Medical Air Lag Compressor in Use.

Medical Air High Water Level in Receiver.

Medical Air High Water Level in Separator.

Medical Air Main Line Pressure High.

Medical Air Main Line Pressure Low.

Medical Air Dew Point High.

Medical Air High Carbon Monoxide.

Medical Air System High Discharge Air Temperature.

Medical Air Compressor High Temperature Shutdown.

Local Alarm.

Medical Vacuum System:

Vacuum Lag Pump In Use.

Main Line Vacuum Low.

Local Alarm.

Instrument Air Source System:

Instrument Air [**Lag Compressor**] [**Cylinder Reserve**] in Use.

Instrument Air Main Line Pressure High.

Instrument Air Main Line Pressure Low.

Instrument Air Dew Point High.

Instrument Air Cylinder Reserve Low Contents.

Local Alarm.

WAGD Source System:

WAGD Lag Pump In Use.

Main Line Vacuum Low.

Local Alarm.

* + - 1. LIQUID OXYGEN STORAGE TANK
				1. Inner Container: ASTM A666 (Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar), Type [**304**] [**316**], welded stainless tank conforming with ASME Section VIII (Boiler and Pressure Vessel Code - Pressure Vessels), ASME labeled for pressure rating of <**\_\_\_\_\_\_\_\_**> psi.
				2. Outer Shell: Welded carbon steel conforming to ASME Section VIII (Boiler and Pressure Vessel Code - Pressure Vessels), with collapse rating of <**\_\_\_\_\_\_\_\_**> psi.
				3. Insulation: Furnish sufficient insulation of annular space for maximum leak evaporation of <**\_\_\_\_\_\_\_\_**> pound of oxygen in 24 hours. Furnish insulation type not capable of sparking or burning when touched with glowing platinum wire in pure oxygen atmosphere.
				4. Supports: Adequate for installed and loaded forces of 1-1/2 times gravity vertical and 1/2 times gravity horizontal and for shipping empty, 3 times gravity.
				5. Valves and Fittings: Conform with NFPA 50 (Standard for Bulk Oxygen Systems at Consumer Sites) and ASME Section VIII (Boiler and Pressure Vessel Code - Pressure Vessels), with:

Manway and cap.

Liquid level gage.

Inner container pressure gage, by-pass valve and vent valve.

95 percent tri-cock valve and gage valve.

Thermocouple valve gage tube and thermocouple.

Inner container relief valve, <**\_\_\_\_\_\_\_\_**> psi setting.

Inner container bursting disc, <**\_\_\_\_\_\_\_\_**> psi rating.

Bottom filling valve.

Vent valve.

Inlet bleed valve.

Liquid filling connection.

Inlet line relief valve, <**\_\_\_\_\_\_\_\_**> psi setting.

Evaporating coil <**\_\_\_\_\_\_\_\_**> gpm at <**\_\_\_\_\_\_\_\_**> psi.

Annular space evacuation valve, evacuation filter, <**\_\_\_\_\_\_\_\_**> sq in.

Pressurizing valve.

Liquid withdrawal valve.

Liquid-to-pump valve.

Pump vapor return valve.

Outer shell O-ring relief valve.

* + - * 1. Pipe and Fittings: ASTM A269 (Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service), Type 304, stainless steel pipe and ASTM A403 (Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings) welding fittings; screwed or flanged valve, gage, and equipment joints.
				2. Tank Finish: Commercial sandblasting clean and finish with primer coat and exterior white with green color code enamel finish.
			1. UNDERGROUND PIPE MARKERS

In this article, list manufacturers acceptable for this project.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=7943&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Craftsmark Identification Systems

Seton Identification Products

W.H. Brady Company

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish materials in accordance with [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standards.

Edit the following descriptive specifications to identify project requirements and to eliminate conflicts with products specified above.

* + - * 1. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

Consider the following paragraph for non-metallic pipe.

Insert appropriate service name.

* + - * 1. Trace Wire: Magnetic detectable conductor, [**clear**] [**brightly colored**] plastic covering, imprinted with "[**Medical Oxygen Service**] [**Medical Gas Service**] <**\_\_\_\_\_\_\_\_**>" in large letters.
			1. LABELING AND IDENTIFICATION

NFPA is very specific in defining labeling and identification requirements. First option below references the standard. The second option is more detailed listing of information taken from NFPA 99.

* + - * 1. Furnish labeling and identification in accordance with NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Pipe Labels:

Furnish pipe labels or stenciling identifying the medical gas or vacuum system. Furnish with name of gas or vacuum system or chemical symbol.

Furnish pipe labels with colors in accordance with NFPA 99 (Health Care Facilities).

When gas system operates at other than standard pressures, include operating pressure in addition to gas name.

* + - * 1. Valve Labels:

Label [**source valve**] [**main line valve**] [**riser valve**] [**and**] [**service valve**] in accordance with NFPA 99 (Health Care Facilities).

Furnish valve with name of gas or vacuum system or chemical symbol. Label with room or area served. Label with caution to not open or close valve in an emergency.

When gas system operates at other than standard pressures, label valve with operating pressure in addition to gas name.

* + - * 1. Cylinders: Label cylinder contents in accordance with CGA C-7 (Guide to the Preparation for Cautionary Labeling and Marking for Compressed Gas Containers).
				2. Outlets and Inlets:

Furnish with name of gas or vacuum system or chemical symbol.

When gas system operates at other than standard pressures, include operating pressure in addition to gas name.

* + - * 1. Alarm Panels:

Label indicating condition monitored.

Label each panel for area of surveillance.

1. EXECUTION
	* + 1. EXAMINATION
				1. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
				2. Verify excavations are to required grade, dry, and not over-excavated.
				3. Verify connection [**to existing piping system**] <**\_\_\_\_\_\_\_\_**> size, location, and invert are as indicated on Drawings.
			2. PREPARATION
				1. Prepare soldered joints in accordance with ASTM B828 (Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Ream pipe and tube ends. Remove burrs.
				2. Remove scale and dirt on inside and outside before assembly.
				3. Prepare piping connections to equipment with flanges or unions.
				4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
			1. INSTALLATION - INSERTS
				1. Provide inserts for placement in concrete forms.
				2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
				3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
				4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
				5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut [**above**] [**flush with top of**] [**recessed into and grouted flush with**] slab.
			2. INSTALLATION - HANGERS AND SUPPORTS

The following reference standard included recommended practice for selection and application of pipe hangers and supports for various service temperatures.

* + - * 1. Install hangers and supports in accordance with MSS SP 69 (Pipe Hangers and Supports - Selection and Application).

NFPA 99 includes table of maximum pipe support spacing. Either refer to table by reference below or include schedule at end of section.

* + - * 1. Install hangers and supports at maximum spacing in accordance with NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Support horizontal piping [**in accordance with NFPA 99.**] [**as scheduled in this section.**]
				2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
				3. Place hangers within 12 inches of each horizontal elbow.
				4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
				5. Support vertical piping at every floor; maximum 15 feet on center. Support riser piping independently of connected horizontal piping.
				6. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install pipe hangers and supports in accordance with Section 220529.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install Work in accordance with [**[State] [Municipality] of <\_\_\_\_\_\_\_\_> [Highways] [Public Work's] standards.**]
			1. INSTALLATION - BURIED PIPING SYSTEMS
				1. Establish elevations of buried piping with not less than <**\_\_\_\_\_\_\_\_**> ft of cover.
				2. Establish minimum separation of <**\_\_\_\_\_\_\_\_**> from [**other services**] [**sanitary sewer piping**] <**\_\_\_\_\_\_\_\_**> piping in accordance with <**\_\_\_\_\_\_\_\_**> code.
				3. Excavate pipe trench <**\_\_\_\_\_\_\_\_**>.
				4. Install pipe to elevation [**as indicated on Drawings**] <**\_\_\_\_\_\_\_\_**>.
				5. Install buried [**oxygen**] <**\_\_\_\_\_\_\_\_**> piping [**within buildings**] [**exterior to buildings**] in protector piping.
				6. Install heat tracing cable within protector piping. Refer to Section <**\_\_\_\_\_\_\_\_**>.
				7. Insulate buried [**oxygen**] <**\_\_\_\_\_\_\_\_**> piping including heat trace cable. Refer to Section 220700.
				8. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding [**4**] <**\_\_\_\_\_\_\_\_**> inches [**compacted**] [**loose**] depth; [**compact to [95] <\_\_\_\_\_\_\_\_> percent maximum density**].
				9. Install pipe on prepared bedding.
				10. Route pipe in straight line.
				11. Install pipe to allow for expansion and contraction without stressing pipe or joints.
				12. Install plastic ribbon tape continuous [**over top of pipe.**] [**buried [6] <\_\_\_\_\_\_\_\_> inches below finish grade,**] above pipe line. Refer to Section 220553.
				13. Pipe Cover and Backfilling:

Backfill trench <**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**>

Maintain optimum moisture content of fill material to attain required compaction density.

After pressure test, evenly backfill entire trench width by hand placing backfill material and hand tamping in [**4**] [**6**] inches compacted layers to [**6**] [**12**] inches minimum cover over top of pipe. Compact to [**95**] <**\_\_\_\_\_\_\_\_**> percent maximum density.

Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.

Do not use wheeled or tracked vehicles for tamping.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install Work in accordance with [**[State] [Municipality] of <\_\_\_\_\_\_\_\_> [Highways] [Public Work's] standards.**]
			1. INSTALLATION - ABOVE GROUND PIPING - MEDICAL GAS SYSTEMS
				1. Install medical gas systems in accordance with NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install vacuum pump exhaust with termination exterior to building with elbow turned down and screen on end of elbow.
				2. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
				3. Cut pipe and tubing accurately and install without springing or forcing.
				4. Slope piping in direction of flow.
				5. Make branch connections in accordance with NFPA 99 (Health Care Facilities).
				6. Pressure Gages:

Install at locations identified in NFPA 99 (Health Care Facilities).

Install capable of being read from standing position.

Install pressure gages located down stream from source valve with demand check fitting.

* + - * 1. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Refer to Section 220529.
				2. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section [**078413**] [**220529**] <**\_\_\_\_\_\_\_\_**>.
				3. Install pipe identification in accordance with this Section.
				4. Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.
				5. Install locks on valves.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install Work in accordance with [**[State] [Municipality] of <\_\_\_\_\_\_\_\_> [Highways] [Public Work's] standards.**]
			1. INSTALLATION - EQUIPMENT

Installation of medical gas systems can be specified by referring to NFPA 99 or by editing the remainder of this article.

* + - * 1. Install medical gas system equipment in accordance with NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Choose between the following paragraphs based on whether project contains source systems or individual components.

* + - * 1. Install [**medical air compressor source system**] [**medical vacuum pump source system**] [**instrument air source system**] [**waste anesthetic gas disposal source**] on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than equipment base on each side. Refer to Section 033000.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install [**medical air compressor**] [**medical vacuum pump**] [**instrument air compressor**] [**waste anesthetic gas disposal vacuum pump**] [**refrigerated air dryer**] [**desiccant air dryer**] [**receiver**] on [**individual**] concrete housekeeping pads, minimum 3-1/2 inches high and 6 inches larger than equipment base on each side. Refer to Section 033000.

Choose between the following paragraphs based on whether project contains source systems or individual components.

* + - * 1. Install [**medical air compressor source system**] [**medical vacuum pump source system**] [**instrument air source system**] [**waste anesthetic gas disposal source**] on vibration isolators. Refer to Section 220548.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install [**medical air compressor**] [**medical vacuum pump**] [**instrument air compressor**] [**waste anesthetic gas disposal vacuum pump**] [**refrigerated air dryer**] on vibration isolators. Refer to Section 220548.
				2. Connect [**units**] [**source system**] to piping with flexible piping connections.

Use the following two paragraphs when source systems are not being specified and individual source components are field installed.

* + - * 1. Install bypass with valves around air dryer.
				2. Install bypass with valves around receivers.
				3. Install [**medical air compressors**] [**and**] [**medical vacuum pumps**] with water supply piped from domestic water system [**as indicated on Drawings**]. Install reduced pressure back flow preventer, shutoff valve and union on water supply. Refer to Section 221100.
				4. Install seal water discharge piping to nearest floor drain.
				5. Install condensate drain piping to nearest floor drain.
				6. Liquid Oxygen Storage Tank:

Install in accordance with NFPA 50 (Standard for Bulk Oxygen Systems at Consumer Sites) [**and under supervision of manufacturer**].

Install with shutoff valve and connection point with valve for portable emergency oxygen supply. [**Install bulk oxygen to inlet side of oxygen manifold.**]

* + - * 1. Install components furnished loose for field mounting.
				2. Install electrical devices furnished loose for field mounting.
				3. Install control wiring between equipment and field installed accessories.
				4. Make connections to equipment with unions or flanges.
				5. Install valves and piping specialties as indicated on Drawings.
				6. Installation - Gas Cylinder Manifolds:

Install relief valve between final pressure regulator and source valve.

Install relief valve vent piping to building exterior, sized at least full size of relief valve outlet.

When connecting vent piping from multiple relief valves into a common vent pipe, size common relief valve vent piping equal or greater than discharge areas of relief valves connected.

Extend relief valve vent piping minimum of 6 feet above pedestrian areas.

Install discharge turned down and with screen at outlet.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Install Work in accordance with [**[State] [Municipality] of <\_\_\_\_\_\_\_\_> [Highways] [Public Work's] standards.**]
			1. LABELING AND IDENTIFICATION
				1. Piping:

Install pipe labels at intervals of not more then 20 feet.

Install minimum of one pipe label in each room.

Install label on each side of wall when penetrated by piping.

Risers: Install minimum of one label for each story traversed by piping.

* + - * 1. Label [**gas**] <**\_\_\_\_\_\_\_\_**> cylinders with either labels or stencils naming contents in accordance with CGA C-7 (Guide to the Preparation for Cautionary Labeling and Marking for Compressed Gas Containers).
			1. FIELD QUALITY CONTROL
				1. Field inspecting, testing, adjusting, and balancing.

Terms used for the following tests and verifications are taken from NFPA 99.

* + - * 1. Installer Performed Tests - Level 1 and Level 2 Systems:

Complete installer performed tests for each system in accordance with procedures specified in NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Perform the following installer performed tests in accordance with procedures specified in NFPA 99 (Health Care Facilities):

Initial blow down.

Initial pressure test.

Cross connection test.

Piping purge test.

Standing pressure test for positive pressure medical gas systems.

Standing pressure test for vacuum systems.

* + - * 1. System Verification Tests - Level 1 and Level 2 Systems:

Perform after completion of Installer Performed Tests.

Conduct test by agency independent of system installer.

Complete system verification tests for each system in accordance with procedures specified in NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Perform the following system verification tests in accordance with procedures specified in NFPA 99 (Health Care Facilities):

Standing pressure test.

Cross connection test.

Individual system pressurization.

Valve test.

Alarm test.

Piping purge test.

Piping particulate test.

Piping purity test.

Final tie-in test.

Operational pressure test.

Medical gas concentration test.

Medical air purity test.

Labeling verification.

Source equipment verification:

Gas supply sources.

Medical air compressor system.

Medical-surgical vacuum systems.

* + - * 1. Initial Tests - Level 3 Systems:

Complete tests for each system in accordance with procedures specified in NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Perform the following tests in accordance with procedures specified in NFPA 99 (Health Care Facilities):

Initial blow down.

Initial pressure test for [**positive pressure gas systems**] [**and**] [**copper vacuum piping systems**].

Initial leak test for PVC vacuum piping systems.

Initial cross connection test.

Initial piping purge test.

Initial standing pressure test for positive pressure gas piping systems.

Initial vacuum pressure test for vacuum systems.

* + - * 1. System Verification - Level 3 Systems:

Perform after completion of Initial Tests.

Conduct test by agency independent of system installer.

Complete system verification tests for each system in accordance with procedures specified in NFPA 99 (Health Care Facilities).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Perform the following system verification tests in accordance with procedures specified in NFPA 99 (Health Care Facilities):

Verifier standing pressure test.

Verifier standing vacuum test.

Verifier cross connection test.

Verifier warning system test.

Verifier piping purge test.

Verifier piping particulate test.

Verifier piping purity test.

Verifier final tie-in test.

Verifier operational pressure test.

Verifier gas concentration test.

Labeling verification.

Source equipment verification.

* + - 1. MANUFACTURER'S FIELD SERVICES
				1. Requirements for manufacturer's field services.

Include the following based on Project conditions.

* + - * 1. Furnish initial start-up including routine servicing and checkout.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Furnish services of factory trained representative for minimum of [**one**] <**\_\_\_\_\_\_\_\_**> days to [**start-up equipment**] [**and**] [**calibrate controls**].
			1. DEMONSTRATION
				1. Requirements for demonstration and training.
				2. Demonstrate each [**piece of equipment**] [**medical gas system**] operation and maintenance.

Include the following based on Project conditions.

* + - * 1. Furnish services of manufacturer's technical representative for [**one**] <**\_\_\_\_\_\_\_\_**> [**8**] <**\_\_\_\_\_\_\_\_**> hour day to instruct Director’s Representative's personnel in operation and maintenance of [**medical gas equipment**] <**\_\_\_\_\_\_\_\_**>.
			1. ATTACHMENTS

When relying on separate schedules, tables, illustrations, or forms to specify product requirements, include list of each attachment. Include identical list of attachments in Project Manual table of contents.

Insert attachments following END OF SECTION. Consider following examples when developing Project schedule.

* + - * 1. Valve Shutoff Service:

Medical Oxygen - Levels 1 and 2: Valve BA-1.

Medical Compressed Air - Levels 1 and 2: Valve BA-1.

Nitrous Oxide - Levels 1 and 2: Valve BA-1.

Nitrogen - Levels 1 and 2: Valve BA-1.

Medical Vacuum - Levels 1 and 2: Valves BA-1, BA-2, BA-3, BF-1, and BF-2.

Waste Anesthetic Gas Disposal - Levels 1 and 2: Valves BA-1, BA-2, BA-3, BF-1, and BF-2.

Instrument Air - Levels 1 and 2: Valve BA-1.

Medical Oxygen - Level 3: Valve BA-1.

Medical Compressed Air - Level 3: Valve BA-1.

Nitrous Oxide - Level 3: Valve BA-1.

Nitrogen - Level 3: Valve BA-1.

Medical Vacuum - Level 3: Valves BA-2, BA-3, BA-4, BF-1, and BF-2.

Waste Anesthetic Gas Disposal - Level 3: Valves BA-2, BA-3, BA-4, BF-1, and BF-2.

Instrument Air - Level 3: Valve BA-1.

Oral Evacuation: Valves BA-2, BA-3, and BA-4.

NFPA 99 includes schedule for pipe hanger spacing. The following schedule matches table in NFPA. Either refer to standard in specification text or include schedule below.

* + - * 1. Pipe Hanger Spacing:

Pipe Size 1/4 Inch:

Maximum Hanger Spacing: 5 feet

Hanger Rod Diameter: 3/8 inch

Pipe Size 3/8 Inch:

Maximum Hanger Spacing: 6 feet

Hanger Rod Diameter: 3/8 inch

Pipe Size 1/2 Inch:

Maximum Hanger Spacing: 6 feet

Hanger Rod Diameter: 3/8 inch

Pipe Size 3/4 Inch:

Maximum Hanger Spacing: 7 feet

Hanger Rod Diameter: 3/8 inch

Pipe Size 1 Inch:

Maximum Hanger Spacing: 8 feet

Hanger Rod Diameter: 3/8 inch

Pipe Size 1-1/4 Inches:

Maximum Hanger Spacing: 9 feet

Hanger Rod Diameter: 3/8 inch

Pipe Size 1-1/2 Inches and Larger:

Maximum Hanger Spacing: 10 feet

Hanger Rod Diameter: 3/8 inch

END OF SECTION 226000