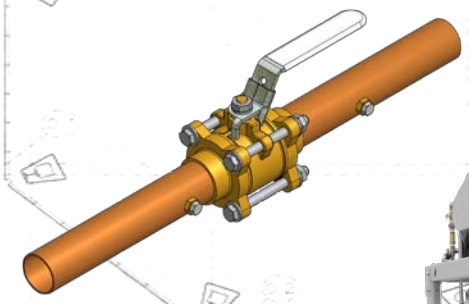
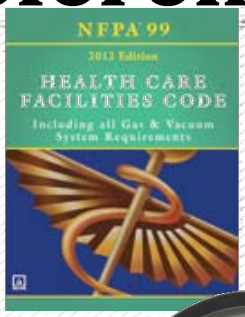
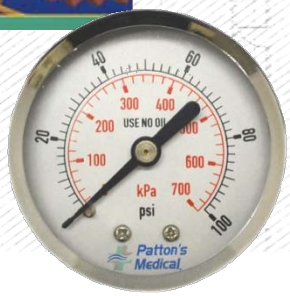
Patton's Medical

Medical Gas Specification Guide

Engineer's Reference







June 5, 2014

Medical Gas Guide Specifications

NOTE TO SPECIFIER: Choices are indicated in {*Italics*} and options are indicated by >OR<. Choose one of the listed options.

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SECTION 226000 - MEDICAL GAS, VACUUM AND WAGD SYSTEMS

PART 1.0 - GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of the Contract, including general and supplementary conditions and Division I specification section, apply to this section.

1.2 SUMMARY EXTENT OF WORK

A. This Section pertains to all labor, equipment and services necessary for and incidental to the installation of piped medical gas and vacuum systems (PMGVS) including oxygen, medical air, medical vacuum, waste anesthesia gas disposal (WAGD), nitrogen, instrument air, nitrous oxide, helium, carbon dioxide, argon, dental air, dental vacuum, laboratory air and mixed gas systems as shown on the drawings and/specified herein.

1. Oxygen systems shall be complete to the source valve, ready for connection to the bulk gas supply system.

2. Medical Vacuum, WAGD and Medical Air systems shall be complete, started, tested and ready for use.

3. Nitrous Oxide, Nitrogen, Carbon Dioxide, Helium, Argon and Mixed Gas Systems shall be complete, tested and ready for use.

B. Owner Furnished Materials for installation under this section

1. Supply of gases in cylinders or containers as appropriate for manifolds.

2. Initial supply of liquid (oxygen, nitrogen).

Specifier, if owner will supply bulk liquid gas sources, use this paragraph:

3. Bulk Cryogenic (Oxygen, Nitrogen) System. Coordinate all plumbing and alarm connections to the bulk gas source, source start up and system testing, providing owner with system ready for use.

1.3 DEFINITIONS AND REFERENCES: All references refer to the most recent edition.

A. National Fire Protection Association (NFPA), NFPA 99 Health Care Facilities.

B. National Fire Protection Association (NFPA), NEC National Electrical Code.

C. American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers.

D. American Society of Sanitary Engineers (ASSE) 6030 Professional Qualification Standards for Medical Gas System Verifiers.

1.4 PERFORMANCE REQUIREMENTS

A. All materials used shall be new and of the best grade and quality obtainable and workmanship shall be first class in every respect. Contractor shall be responsible for compliance with all Local, State or Federal codes.

B. Provide all elements and accessories required for complete systems per NFPA 99 most recent edition.

C. Contractor shall make all necessary connections to owner furnished equipment.

D. Install all piping as shown on Drawings, as described herein and as described in Section 15050, Basic Materials and Methods, using methods of fabrication, grading, testing, repairing, cleaning and other procedures as described.

E. Electrical power wiring for vacuum pump(s), medical air compressor(s), WAGD Producer(s), ceiling columns, alarms, and modular accessories associated with the system(s) shall be part of the electrical contract. Any equipment supplied by this contractor that requires additional electrical services shall be the responsibility of this contractor to supply these services.

F. Perform Installer pressure testing, cross connection testing and final testing per NFPA 99 most recent edition and using procedures as specified

Specifier, if contractor will retain Verifier, use this paragraph:

G. Retain a qualified third party verifier acceptable to the engineer and owner to Perform and attest to final verification of the systems. Make corrections as required, including additional testing if necessary to attain full and unqualified certification.

OR if Owner will retain Verifier, use this paragraph:

H. Coordinate with owner retained verifier for final verification of the systems. Make corrections as required, including additional testing if necessary to attain full and unqualified certification.

1.5 COORDINATION

A. Medical Gas Contractor shall coordinate with other trades to ensure timely installations and avoid conflicts and interference.

B. Work with metal stud partition installer and/or mason to ensure anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.

C. Coordinate with owner to ensure medical gas outlets, whether owner supplied or contractor supplied, in walls, ceiling and all equipment is provided by the same Medical Gas Equipment Manufacturer (MGEM) satisfactory to the owner.

D. Coordinate with bulk cryogenic gas supplier for installation, connection and verification of bulk gas supply systems.

E. Medical Gas Contractor shall supply and install the master alarm system, including the signal wiring. The electrical contractor shall provide power wiring to each alarm panel. Medical Gas Contractor is responsible for proper termination, testing and marking of alarm panels. Termination shall be done by or under supervision of manufacturer of alarm panels.

F. Coordinate with Medical Gas Verifier to deliver a complete, tested medical gas installation ready for owner's use.

1.6 SUBMITTALS

A. Furnish the following as one package:

1. Medical Gas Equipment Manufacturer (MGEM) submittals including at least;

    a. Complete specifications for the product intended to be installed, dimensional drawings, and wiring schematics where appropriate.

    b. For Medical Air, medical vacuum and WAGD plants include:

        (i) Package drawing indicating package style, dimensions when complete, method of disassembly and sizes of subsections for rigging and installation.

        (ii) Compressor and package capacity expressed in ICFM.

        (iii) Lubrication method (if any).

        (iv) Drive detail including adjustment method.

        (v) Motor including manufacturer, frame type, service factor, horsepower, current draw, and RPM.

        (vi) Air filters including type and replacement element.

        (vii) Pressure regulators including type and manufacturer.

        (viii) Dew point monitor including technology employed, calibration interval and annual drift in degrees.

        (ix) Carbon monoxide monitor including technology employed, calibration interval and annual drift in ppm.

        (x) Air dryers, type; manufacturer; and design dew point at 50 psig.

        (xi) Sound pressure in dBa when operated at NFPA capacity.

        (xii) BTU output for the equipment

    c. For other medical gas products include:

        (i) Outlet keying system.

        (ii) Alarms networking instructions.

    d. Complete installation instructions for the use of the installer.

    e. Statement of specific compliance with paragraphs of NFPA 99 most recent edition as relevant to the equipment and as listed in those sections.

    f. Complete maintenance schedules.

    g. Warranty statement which must encompass all system components. Warranties covering only specific components or containing exclusions are not acceptable.

    h. Name and contact information for installation assistance, startup, warranty and service.

i. Description of available Preventative Maintenance programs for Owners review.

j. Information on training programs available to maintenance personnel for Owners review.

B. Medical Gas Verifier Submittals shall include:

1. Name, contact information, MGPHO Credential Number and reference list. The reference list is to include not fewer than three references on projects of similar size and complexity.

2. A notarized affidavit from the verifier stating that the verifier undertakes to verify this project and thus agrees to disqualify themselves from supplying any equipment which will be included in the scope of their verification. No verifier who supplies equipment shall be permitted to verify that equipment or the system in which it is installed.

3. Statement declaring that the MGEM has no fiduciary interest in the verifier and that the verifier is not an agent or representative of the MGEM.

4. Statement declaring that the installing contractor has no fiduciary interest in the verifier and that the verifier has no fiduciary interest in the contractor.

C. Pre-approval;

1. Written pre-approval is required for equipment not exactly matching specifications. Submit the information required under Submittals above, attaching a cover letter stating the exact areas of deviation.

2. A Request for pre-approval of equipment must be received by the Engineer not less than three days (72 hours) prior to bid.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements

1. Electrical Control systems and Medical Gas Alarms are to be UL listed as assemblies with label affixed.

2. Medical air, instrument air, medical vacuum and WAGD controls are to be wired in accordance with NEC.

3. MGEM will include with submittals an affidavit attesting to compliance with all relevant paragraphs of NFPA 99 most recent edition.

4. MGEM personnel assembling medical air, instrument air, vacuum and WAGD plant shall meet NFPA 99 5.1.10.10.11 “Qualification of Installers” and hold medical gas endorsements as under

ASSE 6010.

5. The Contractor shall furnish documentation attesting that all installed piping materials were purchased cleaned and complied with the requirements of NFPA 99 5.1.10.1 and 5.1.10.2.

6. The Contractor shall furnish copies of ASSE 6010 qualifications for all workers installing medical gas piping.

B. Installation and Start-up: The MGEM will provide factory authorized representatives to review installation and perform initial start up of system.

C. Warranty

1. Warranty will be expressly complete, include all components of the system and be the responsibility of the MGEM of record only. Warranties limiting the responsibility of the MGEM for any system component or which pass through the MGEM to another manufacturer are not acceptable.

2. Warranties shall include on site repairs including travel, labor and parts. Warranties requiring return of equipment for adjustment are not acceptable.

3. All medical gas pipeline components shall be warranted by the MGEM of record for a minimum of twelve months from start-up.

D. Maintenance

1. MGEM shall demonstrate a national factory direct service capability able to perform major overhauls.

2. MGEM shall offer factory direct preventative maintenance contract for the owner's consideration.

3. MGEM shall offer formal maintenance training courses for owners review.

E. Verification: Medical Gas Contractor shall deliver to the owner a complete system certification without qualifications.

PART 2 - PRODUCTS

2.1 QUALIFICATION OF MANUFACTURER(S)

A. One Medical Gas Equipment Manufacturer (MGEM) shall supply the medical-gas system(s) and equipment to include outlets, valves and gauges, valve boxes, alarm panels, manifolds, medical air, instrument air, vacuum and WAGD sources.

B. The MGEM shall have a product specialist available to periodically check with the Contractor during installation of the pipeline systems equipment. MGEM shall provide service support to the hospital after turnover. Demonstrate factory trained service technician is available within 200 miles of facility.

C. Approved MGEM: Piping Systems Components and Medical Gas Alarms;

1. Patton's Medical
2. Alternate by _____ with pre approval.

D. Written Pre-approval is required for all equipment from other manufacturers.

2.2 MATERIALS

A. All pressurized medical gas piping shall be;

1. Seamless ASTM B-819, type K or L hard drawn seamless medical gas copper tubing, identified by the markings "OXY" "MED" "OXY/MED" "OXY/ACR" , or "ACR/MED" in green (Type K) or blue (Type L).
2. Fittings shall be wrought copper, brass or bronze designed expressly for brazed connection, compliant with ANSI B16.22.
3. Pipe (Tube), fittings, valves, and other components shall be specially cleaned for oxygen service in a facility equipped to clean, rinse, and purge the material in accordance with the requirements of NFPA 5.1.10.1.1 and received on job site cleaned and capped. On site cleaning of the interior surfaces of tubes, valves, fittings, and other components is not allowed.
4. Brazing alloy shall be BCuP-5 Brazing alloy or equivalent alloy with at least 1000 degree F melting

point.

B. All vacuum tubing shall be:

1. Type 'L', 'M', or ASTM B-280 ACR copper.
2. Brazed with BCuP-5 Brazing alloy or equivalent alloy with at least 1000 degree F melting point.

C. All WAGD piping shall be:

1. Type 'L', 'M', or ASTM B-280 ACR copper, Schedule 5 galvanized steel, or equivalent sized ductwork.
2. If copper, brazed with BCuP-5 Brazing alloy or equivalent alloy with at least 1000 degree F melting point.

D. Isolation of copper tubing from dissimilar metal shall be accomplished either through use of copper or copper plated hangers or hangers with plastic isolators.

2.3 SUBSYSTEMS

A. MEDICAL GAS WALL OUTLET STATIONS:

Specifier, alter paragraph to reflect owners preference of outlet style.

1. Medical gas wall outlet stations shall be modular, quick-disconnect recessed type, or DISS screw thread recessed type equal to Patton's Medical. Threaded DISS connector shall be per CGA standards.
2. Specifier, if "match existing" is required, add this paragraph.

Provide keying systems compatible with existing keying system.

3. Outlets shall be field assembled with sequences and services indicated. Centerline spacing of multiple outlets shall be 5 inches minimum.

4. Outlets shall be compatible with Ohmeda, Puritan-Bennett, or Chemetron
5. Outlet stations shall have a light gray coated Cycoloy® non-metallic trim plate. Furnish indexed rough in and gas specific latch valve with non-interchangeable safety keying and with color coded gas service identification. The safety keying index pins shall be permanently captured in the latch assembly and non-removable without destroying the outlet. Designs with index pins molded in plastic are not acceptable.
6. The latch mechanisms shall be designed for one handed, single thrust mounting and one handed fingertip release of secondary equipment.
7. The complete outlet shall be made, cleaned and packaged to NFPA 99 Standards, UL Listed and CSA certified. Medical gas outlets shall be cleaned for oxygen service in accordance with CGA Pamphlet G-4.1. The rough in and latch assembly shall be poly bagged for shipment.
8. The rough in assembly shall be of modular design and include a gas specific 16 gauge steel mounting plate designed to permit on-site ganging of multiple outlets, on 5 inch center line spacing. A machined brass outlet block shall be permanently attached to the mounting bracket to permit the 1/2" OD, type-K copper inlet to swivel 360 degrees for attachment to the piping system. The rough in assembly shall contain a double seal to prevent gas leakage between the rough in and latch-valve assemblies after the wall is finished. The rough in shall have two features to prevent debris from entering outlet, one shall be the dust cover and the other will be a cap over the inter seal.
9. The latch-valve assembly shall telescope up to 3/4" to allow for variation in finished wall thickness from 1/2" to 3/4".
10. All vacuum outlets shall have a pressure plug for testing purposes.

10. Model Number Series:

    Ohmeda: O1-QDWAL-*GAS*

    Puritan: O1-PBWAL-*GAS*

    Chemetron: O1-CHWAL-*GAS*

    DISS: O1-DIWAL-*GAS*

B. MEDICAL GAS CEILING OUTLETS:

1. DISS Outlets shall be used for all ceiling mount applications.
2. Model Number: O1-DICEI-*GAS*
3. Inlet pipe shall come straight out the outlet body (not 90 degree) for easier installation.
4. Furnish hose assemblies for all ceiling outlets for the finished ceiling height as indicated on drawings. Provide each hose with a heavy-duty dual retractor for pressure gases and dual for vacuum. The hose retractor wire is manufactured out of 48" stainless steel heavy duty cable. Allow an extra 18" of hose length for retractors.

C. GAS (NIT, CO2, INA) CONTROL PANELS:

1. Gas control panels shall be designed to deliver variable pressures to power pneumatic surgical tools.
2. The control panel shall be provided with a 0-300 psig pressure gauge, shutoff valve, pressure regulator, delivery pressure gauge and outlet. A quarter turn of the valve handle shall be required to obtain a fully "open" or "closed" position.
3. An adjustable self relieving type pressure regulator, with a operating range of 10 to 250 psi.
4. Control panels shall be pre-piped internally requiring only external supply line connections. Additional outlets in the same room may be connected to the remote outlet pigtail furnished in the control panel. Remote outlets shall be regulated by the adjustable pressure regulator within the panel and shall match the nitrogen control panel outlet.
5. Control panels shall be available in horizontal or vertical orientation.

PATTON'S MEDICAL MODEL: GCP-H-NIT (Nitrogen)

GCP-H-INA (Instrument Air)

GCP-H-CO2(CO2)

D. MEDICAL GAS VALVES

1. All Medical Gas Valves shall be specially prepared for oxygen service and shall conform to NFPA 99. Valves shall be ball-type, with Teflon seats and adjusting stem packing gland with Teflon stem seal.

2. Ball valves shall be rated 600 WOG, actuate from full "ON" to full "OFF" by 90 degree turn of vinyl gripped valve handle.

3. Furnish and install only valves with factory installed type K copper tubing extensions.

4. Valves not in valve boxes shall be provided with locking handles. (locks to be provided by contractor to owner).

5. Ball valves shall have dual ports.

6. All valves shall be cleaned for oxygen, capped and sealed in a polyethylene bag for shipping and storage.

PATTON'S MEDICAL MODEL PMIV-2L-*XXX*

E. ZONE VALVE BOXES

1. Valve boxes shall be constructed of 18 gauge steel with white enamel finish. The valve box shall have a pull out, opaque door with pull ring and clear gauge window. The removable window cannot be replaced when any valve is closed. The frame assembly shall be capable of adjusting for variances in wall thickness up to 1-3/16". The window shall conceal piping and mounting screws. Window shall be labeled "Caution - Medical Gas Shut - Off Valves - Close Only in Emergency." Provide clear viewing space in the window to display the gas service, the pressure gauges and the label for areas controlled by the valve.

2. Provide color coded self-adhesive gas labels for compliance with NFPA 99 labeling requirements. Apply labels to each valve in the assembly for gas service identification according to manufactures recommendations.

3. Valve box shall house one to six valves.

4. Zone valves shall include a 1 1/2 inch pressure gauge reading 0 to 100 psig for oxygen, air, nitrous oxide; 0 to 300 psig for nitrogen; and 0 to 30 HG for vacuum and WAGD. The gauge port shall be equipped with removable plug for pressure testing before final assembly of gauge.

5. All zone valve boxes assemblies shall read pressure downstream and vacuum upstream of the valve per NFPA 99. Valves shall be piped left to right with right being on patient side.

6. All main line, riser, service, and futures valves as scheduled on the drawings shall include plugged 1/8 nptf ports on inlet and outlet.

PATTON'S MEDICAL MODEL PMZVB-*XX*

F. ZONE VALVE BOX WITH SENSOR FOR REMOTE ALARM

1. Valve boxes shall be constructed of 18 gauge steel with white enamel finish. The valve box shall have a pull out, opaque door with pull ring and clear gauge window. The removable window cannot be replaced when any valve is closed. The frame assembly shall be capable of adjusting for variances in wall thickness up to 1-3/16". The window shall conceal piping and mounting screws. Window shall be labeled "Caution - Medical Gas Shut - Off Valves - Close Only in Emergency." Provide clear viewing space in the window to display the gas service, the pressure gauges and the label for areas controlled by the valve.

2. Provide color coded self-adhesive gas labels for compliance with NFPA 99 labeling requirements. Apply labels to each valve in the assembly for gas service identification according to manufactures recommendations.

3. Valve box shall house one to six valves.

4. Zone valves shall include a 1 1/2 inch pressure gauge reading 0 to 100 psig for oxygen, air, nitrous oxide; 0 to 300 psig for nitrogen; and 0 to 30 HG for vacuum and WAGD. The gauge port shall be equipped with removable plug for pressure testing before final assembly of gauge.

5. All zone valve boxes assemblies shall read pressure downstream and vacuum upstream of the valve per NFPA 99. Valves shall be piped left to right with right being on patient side.

6. Each valve shall have a gas specific DISS demand check valve for installation of a DISS gas specific sensor. Low voltage wiring to remote alarm by this contractor

7. Area alarm will not require sensors.

PATTON'S MEDICAL MODEL PMZVB-P*XX*

G. COMBINATION ZONE VALVE/AREA ALARM

1. Valve boxes shall be constructed of 18 gauge steel with white enamel finish. The valve box shall have a pull out, opaque door with pull ring and clear gauge window. The removable window cannot be replaced when any valve is closed. The frame assembly shall be capable of adjusting for variances in wall thickness up to 1-3/16". The window shall conceal piping and mounting screws. Window shall be labeled "Caution - Medical Gas Shut - Off Valves - Close Only in Emergency." Provide clear viewing space in the window to display the gas service, the pressure gauges and the label for areas controlled by the valve.

2. Provide color coded self-adhesive gas labels for compliance with NFPA 99 labeling requirements. Apply labels to each valve in the assembly for gas service identification according to manufactures recommendations.

3. Valve box shall house one to six valves.

4. Zone valves shall include a 1 1/2 inch pressure gauge reading 0 to 100 psig for oxygen, air, nitrous oxide; 0 to 300 psig for nitrogen; and 0 to 30 HG for vacuum and WAGD. The gauge port shall be equipped with removable plug for pressure testing before final assembly of gauge.

5. All zone valve boxes assemblies shall read pressure downstream and vacuum upstream of the valve per NFPA 99. Valves shall be piped left to right with right being on patient side.

6. Each valve shall have a gas specific sensor installed with DISS nut & nipple.

7. The area alarm shall be part of the valve box. No remote alarm shall be required.

PATTON'S MEDICAL MODEL PMAVC-LN-*XX*

H. MEDICAL GAS ALARM SYSTEMS

General Requirements

a. All Medical Gas Alarm panels shall be UL listed as an assembly and shall include factory wiring, transformers, and circuitry requiring only 115 or 230 volt primary power.
b. Alarm panels shall meet the FCC Part 15, Subpart B and ICES-003 to reduce possibility of magnetic radiation interference with other equipment.
c. The alarm shall arrive on the job site pre-configured as shown on the drawings and schedules or shall be configured by MGEM personnel at no additional charge.
d. Alarm shall supervise its wiring to sensors and switches, indicating at the relevant panel(s) if any wire is cut, disconnected or open.
e. Each signal will include an indicator light to signify the condition monitored. Activation of any switch will light its LED or LCD "Tag Name" and actuate the audio alarm.
f. Each panel shall include a power on indicator and test function for testing all modules electrically.
g. Alarms shall include features permitting field adjustment of alarm volume and display intensity.
h. Termination of alarm wiring to be done by or under supervision of manufacturer of alarm.

1. Master Alarms

a. Furnish exact duplicate Master Alarm Panels at the two locations shown on the plans.
b. Wire the master alarm panel's alarms directly to the individual sensors/switches, furnishing duplicate sensors/switches as required for compliance with NFPA 99 5.1.9.2.4. Low voltage shielded wire shall be provided and installed by this contractor.
c. Alarms shall be tested, labeled and fully operational for owner. Where alarm configuration in software is necessary, it shall be provided by MGEM representative at no additional charge.
d. Provide alarm points as indicated in NFPA 99 Table A.5.1.9.2. and as detailed on drawings.
e. Alarm shall have a repeat alarm function.
f. Shall be capable of interfacing with a building management system.
g. Ethernet compatible.
h. Alarm shall have capability of combination Master/Area
i. Alarm manufacturing shall provide a wiring diagram with submittals.

PATTON'S MEDICAL MODEL A1M30

2. Area Alarms

a. Each area alarm shall include a rough in including power supply, a sensor for each specific gas, and one digital display for each specific gas.
b. The power supply shall be of the universal switching type (100-250VAC, 50/60/440Hz, 120-300VDC). Power supply shall be fused to protect the system from voltage and amperage surges. Alarm shall clearly indicate when power is on.
c. The area alarm shall provide an audible and visual signal when an advisory or a fault signal is received. Signal limits shall be factory set, with the ability to be field adjusted without the use of tools.
d. Each panel shall provide continuous digital display of the vacuum or pressure, high pressure LED indicator, low pressure (or vacuum) LED indicator and a Normal LED indicator.
e. The Sensor shall contain a transducer to drive the Digital Module. Sensors shall be gas specific, provided with integral demand checks and capable of mounting directly in the gas pipeline system above the ceiling. Connectors shall be provided for attaching field wiring.
f. Furnish and install the alarm. Coordinate the power wiring with Division 16. Low voltage shielded signal wiring will be provided and installed by this contractor.
g. Termination of signal wiring at alarm location will be done by or under supervision of manufacturer of alarm.

PATTON'S MEDICAL MODEL A1CMPL-*XXX*

I. Liquefied Bulk Gas Sources

Specifier, determine which method the owner prefers and use the appropriate section:

1. *The liquid bulk gas source(s) shall be provided by the gas supplier under separate contract with the Owner. Medical Gas Contractor to coordinate with supplier and verifier to ensure a complete and verified installation properly connected to the Medical Gas contractor's work.*

OR

1. *The liquid bulk gas source(s) shall be provided by the Owner. Medical Gas Contractor shall indicate in their bid what contractor shall be responsible to install this equipment. Medical Gas Contractor to coordinate with Contractor installing the source (if not themselves) and verifier to ensure a complete and verified installation properly connected to the Medical Gas contractor's work.*

2. The concrete equipment pad, concrete delivery pad and fencing shall be furnished under other divisions.

3. Lighting and electrical power shall be furnished and installed under Division 16. The Medical Gas Installer shall coordinate installation and connection of signal wiring to alarm panels.

5. Medical gas contractor shall install and verify prior to the installation of the liquid bulk gas source(s):

a. The main line from the equipment location to the building, stubbed up and capped at the equipment pad in the location determined by consultation with the Contractor installing the source.

b. The main line valve.

c. Emergency oxygen inlets, with supply line and associated components in locations as required by NFPA 99 5.1.3.4.14, as otherwise in accordance with NFPA 99, and as indicated on the drawing. Emergency oxygen supply connection shall be as manufactured by .Patton's Medical

5. If the Emergency Oxygen Inlet location as shown on drawings is not found to be accessible by delivery vehicles for any reason, inform the engineer for possible relocation prior to final installation.

J. Gas Cylinder Manifolds

1. Manifolds shall meet the requirements of NFPA 99 5.1.3.4.9. and 5.1.3.4.10.

2. The manifold control(s) shall be fully automatic, including shifting to secondary bank when the service bank is exhausted, with automatic rotation of replaced bank into secondary status. Semi-automatic manifolds are not acceptable.

3. The manifold control(s) shall incorporate:

   a. Pressure switches to actuate designated signals when service bank is exhausted.

   b. Visible display on control unit to determine when primary bank is exhausted and the secondary bank is in operation.

   c. A continuously lit green indicator to indicate header in use.

   d. Gauges to indicate contents of each header.

   e. An amber indicator of header ready for the secondary header.

   f. A red indicator of header empty for each header.

   g. A pressure gauge for line pressure.

4. Manifold design shall ensure that the failure of any one component does not prevent continued supply of gas to patients.

6. Oxygen manifolds shall not include polymeric materials.

   a. Furnish Copper pigtails. Flexible leads with polymeric linings are not acceptable.

   b. Cylinder check valves shall contain no Teflon or Kel-F.

7. Contractor shall furnish and install or field fabricate cylinder storage racks adequate to restrain the anticipated number of cylinders while attached to the manifolds.

8. Contractor shall furnish and install or field fabricate cylinder storage racks adequate to restrain the number of cylinders indicated on the plans while in storage.

9. Manifolds which cannot perform switching operations as per NFPA 99 5.1.3.4.10.5 without electrical power are not acceptable

10. Manifolds shall be Patton's Medical with sizes as scheduled on the plans.

K. Liquid Container Manifolds

1. Manifolds shall at least meet the requirements of NFPA 99 5.1.3.4.12.

2. The manifold control(s) shall be fully automatic, including shifting to secondary bank when the primary bank is exhausted with automatic rotation of replaced bank to secondary status. Semi-automatic manifolds are not acceptable.

3. The manifold control(s) shall incorporate:

    a. Pressure switches to actuate designated signals.

    b. Visible display on control unit to indicate when either bank is exhausted and the secondary bank is in operation.

    c. An indicator of header ready for the secondary header.

    d. Visible display on power supply box to indicate when Reserve is in operation.

    e. Visible display on power supply box to indicate when reserve contents are low.

    f. A continuously lit green indicator to indicate header in use.

    g. Gauges to indicate contents of each header.

    h. A pressure gauge for line pressure.

4. Manifold shall include all reserve header components necessary to complete a manifold with reserve. Header shall include at least the number of connections scheduled on the plans.

5. Reserve headers shall be separate sub assemblies suitable for mounting separate from the manifold controls using standard Type K tubing and brazing techniques. No special piping materials or techniques shall be required.

6. Wiring between the power supply and reserve pressure switch shall be by installing contractor.

7. Manifold design shall ensure that the failure of any one component does not prevent continued supply of gas to patients.

9. Oxygen reserve headers shall not include polymeric materials.
    a. Furnish Copper pigtails. Flexible leads with polymeric linings are not acceptable.
    b. Cylinder check valves shall contain no Teflon or Kel-F.
10. Contractor shall furnish and install or field fabricate cylinder storage racks adequate to restrain the anticipated number of containers and cylinders while attached to the manifolds.
11. Contractor shall furnish and install or field fabricate storage racks adequate to restrain the number of containers and cylinders indicated on the plans while in storage.
12. Manufacturer shall include with the manifold one copy of an applications guide describing the operation of liquid manifolds and their limitations for the operator's use.
13. Manifolds which cannot perform switching operations as per NFPA 99 5.1.3.4.10.5 without electrical power are not acceptable
14. Manifolds shall be Patton's Medical with sizes as scheduled on the plans.

L. Medical Vacuum Pumps

Selection Assistance:

Vacuum Technology	Advantages	Disadvantages
Dry Rotary Vane	+Less expensive Technology +Quiet Operation +Runs Cooler	-Vane Replacement every 3,000 hours -Overall Pump Life is shorter
Lubricated Rotary Vane	+Quiet Operation	-Environmental issues with oil disposal
Contactless Claw	+Low maintenance	-23-25" Hg maximum, altitude sensitive

Specifier, determine the size of vacuum plant required and place on the medical gas schedule.

1. Provide a complete medical vacuum source, complying with NFPA 99 5.1.3.6 in all respects, as specified and scheduled on the drawings and as manufactured by Patton's Medical or pre-approved equal.

2. All components shall be at least duplexed and valved (or check-valved as provided in NFPA-99) to permit service to any component without interrupting vacuum supply to the facility during any maintenance operation or any condition of single fault failure. Each pump exhaust shall be isolated by a union fitting permitting capping for service removal.

3. Furnish complete plant consisting of pumps, receiver and controls capable of providing the scheduled capacity with one pump out of service. All capacities will be indicated in SCFM at 19 inches HG.

4. System shall be completely factory assembled, requiring only interconnection between modules on site. Systems requiring on site assembly other than interconnection are not acceptable (replacement of components removed for shipping is permitted).

5. Each pump will be direct or close coupled to a NEMA rated Premium Efficiency TEFC motor with a service factor of 1.15.

6. Each pump will include exhaust flex connectors supplied by the MGEM.

   Each system inlet connection per latest NFPA 99 Code, furnished by competent installing contractor

7. Programmable Logic Controllers (PLC) will be used to implement operating logic. PLC has integral memory and EPROM backup. PLC shall control the automatic alternation of the vacuum pumps with provisions for simultaneous operation if required, and automatic activation of reserve unit if required. Alternation based on a first-on/first-off principle. Lag alarm, High Temp Shut Down contacts for the master alarm will be provided.

8. The complete control system (Duplex, Triplex, Quadraplex…) and all electrical components shall be NEMA 12 and UL labeled. The control system shall provide:

   a. Automatic lead/lag sequencing including self adjusting minimum run timers which adaptively optimize the number of pump starts based on demand.

   b. Non-proprietary system components that do not require the equipment's owner to source replacement components to the Original Equipment Manufacturer (OEM) out of necessity.

   c. Circuit breaker disconnects for each vacuum pump with external operators. Units with fuses instead of circuit breakers in motor circuit are not acceptable. The control system shall include an automatic minimum run time adjustment to automatically adjust run time based on demand.

   d. Full voltage motor starters with overload protection.

   e. Redundant 120 volt control circuit system transformers, one for each motor circuit to provide automatic switch-over on loss of control power.

   f. Visual and audible reserve unit alarm with isolated contacts for remote alarms and audio cancel.

   g. Control cabinet shall have HOA selector switches

   h. HMI (Human Machine Interface) – touch screen display vacuum display, runtime display,

alarm history display, maintenance schedule and history display, service indicator, replacement parts display, battery backup for history display, hour-meter for each pump.

Specifier, if Variable Frequency Drive (VFD) is required with Claw technology, use this paragraph instead:

8. *The complete control system (Duplex, Triplex, Quadruplex) and all electrical components shall be NEMA 12 and UL labeled. The control system shall provide:*

   a. *Variable frequency drive to control one pump at a time*

   b. *Automatic lead/lag sequencing including self adjusting minimum run timers which adaptively optimize the number of pump starts based on demand.*

   c. *Non-proprietary system components that do not require the equipment's owner to source replacement components to the Original Equipment Manufacturer (OEM) out of necessity.*

   d. *Circuit breaker disconnects for each vacuum pump with external operators. Units with fuses instead of circuit breakers in motor circuit are not acceptable. The control system shall include an automatic minimum run time adjustment to automatically adjust run time based on demand.*

   e. *Redundant 120 volt control circuit transformers.*

   f. *Visual and audible reserve unit alarm with isolated contacts for remote alarms and audio cancel.*

   g. *Control cabinet shall have HOA selector switches*

   h. *HMI (Human Machine Interface) – touch screen display with vacuum display, alarm history display, battery backup for history display for each pump*

   i. *must incorporate a backup mode of operation whereby if the drive goes into fault it automatically changes to a backup mode and all pumps are available as across the line full voltage. This allows for reliability and functionality of all pumps in the event of drive failure*

   j., *the VFD should be isolated via a disconnect whereby the drive can be removed and serviced by a qualified technician safely without shutting down the system.*

Specifier, select the paragraph below reflecting the preferred technology:

FOR LUBRICATED ROTARY VANE

9. NFPA 99 Compliant Lubricated Rotary Vane Medical Vacuum Package:

   a. Capacity of multiple lubricated rotary vane pumps with three non-metallic, non-asbestos vanes with minimum life of 30,000 hrs.

   b. Direct-driven through a shaft coupling

c. Air-cooled

d. Inlet filter and isolation valve for each pump

e. Inlet check valve on each pump

f. Built-in, anti-suck-back valve mounted at each pump inlet

g. Integral, fully recalculating oil supply with spin-on oil filter

h. High discharge temperature switch

i. Integral oil separation system with three stage oil and smoke eliminators capable of removing 99.9+% of particles from the exhaust gas stream

j. 10 micron inlet filter for removal of particulates

k. Vibration isolation mountings.

l. Vacuum pumps are connected to a common manifold and piped to a vertical receiver

m. Flexible connectors between pumps and receiver

n. Flexible connectors for inlet and discharge connections

o. All components completely pre-piped and pre-wired to single point service connections

p. Liquid tight conduit, fittings and junction boxes for all control and power wiring

q. The complete medical vacuum system and all electrical components shall be factory pre-tested prior to shipment by the MGEM.

FOR OIL-LESS ROTARY VANE

9. NFPA 99 Compliant Oil-Less Rotary Vane Medical Vacuum Package:

a. Capacity of multiple "oil-less" rotary vane type vacuum pumps with self-lubricating carbon/graphite vanes

b. Direct-driven through a shaft coupling

c. Air-cooled

d. Inlet filter and isolation valve for each pump

e. Inlet check valve on each pump

f. 5 micron inlet filter for removal of particulates

g. Vacuum relief valve

h. Check valve to prevent backflow through off-cycle units

i. Sealing fluid not required

j. Vibration isolation mountings

k. Vacuum pumps are connected to a common manifold and piped to a vertical receiver

l. Flexible connector between pump and manifold

m. Flexible connectors for inlet and discharge connections

n. All components completely pre-piped and pre-wired to single point service connections

o. Liquid tight conduit, fittings and junction boxes for all control and power wiring

p. The complete medical vacuum system and all electrical components shall be factory pre-tested prior to shipment by the MGEM.

FOR CLAW

9. NFPA 99 Compliant Oil-Less Rotary Vane Medical Vacuum Package:

a. Capacity of multiple "oil-less" rotary claw type vacuum pumps with two claw-type, non-contacting rotors

b. Direct-driven through a shaft coupling

c. Air-cooled

d. Inlet filter and isolation valve for each pump

e. Inlet check valve on each pump

f. Built-in, anti-suck-back valve mounted at each pump inlet

g. 10 micron inlet filter for removal of particulates

h. Vibration isolation mountings

i. Sealing fluid not required - Virtually maintenance-free operation

j. Oil change required at approximately 5,000 operating hour intervals in the gearbox only

k. Vacuum pumps are connected to a common manifold and piped to a vertical receiver

l. Flexible connector between pump and manifold

m. Flexible connectors for inlet and discharge connections

n. All components completely pre-piped and pre-wired to single point service connections

o. Liquid tight conduit, fittings and junction boxes for all control and power wiring

p. The complete medical vacuum system and all electrical components shall be factory pre-tested prior to shipment by the MGEM.

M. Medical Air Compressor System

Specifier, determine the size of medical air plant required and place on the medical gas schedule.

1. Provide a complete medical air source, complying with all relevant requirements of NFPA 99 5.1.3.5 and supplying medical air continuously for the life of the equipment. The unit shall be manufactured by Patton's Medical or pre-approved equal.
2. All components are at least duplexed and valved to permit service to any component without interrupting air supply to the facility.
3. Furnish a complete plant consisting of compressors, receiver, air treatment system and controls capable of providing scheduled capacity with one compressor out of service.
4. System is modular for field separable, allowing for ease of shipment and handling on site. System is completely factory assembled, requiring only interconnection between modules on site. Systems requiring site assembly other than interconnection are not acceptable (remounting of components removed for shipping is permitted).
5. The control system is NEMA 12 and UL labeled. Provide in the control system:
    a. Automatic lead/lag sequencing and alternation.
    b. Non-proprietary system components that do not require the equipment's owner to source replacement components to the Original Equipment Manufacturer (OEM) out of necessity.
    c. A separate circuit breaker disconnect for each compressor internal to the main control cabinet and protected by the safety interlock of that cabinet.
    d. Full voltage motor starters with overload protection.
    e. Redundant 120 volt control circuit system transformers, one for each motor circuit to provide automatic switch-over on loss of control power.
6.
    a. Visual and audible reserve unit alarm with isolated contacts for remote alarm and cancelable audio.
    b. HOA selector switches to provide manual operation independent of the HMI or PLC which provides 100% uptime if the HMI or PLC fails
    c. Human Machine Interface (HMI) touch screen display
    d. When HOA switches are in Hand mode, system will operate on pressure switch and compressors will not run if switch is satisfied.
    e. Provide visual and audible alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm.
    f. A temperature sensor at the outlet of each compressor cylinder or air-end to provide hi-temp alarm and shutdown that compressor. Systems employing a single switch for multiple cylinders are not acceptable.
    g. Dryers are controlled from main control panel with selector switches mounted on control panel.

Specifier, alter this paragraph if other voltages/cycles or phases are required:

6. Compressor motors shall be a NEMA rated, open drip proof unit with 1.15 service factor suitable for 208 or 230/460 volt, three phase, 60hz.

7. All moving parts (fans, pulleys and belts) shall be fully protected by an OSHA approved enclosure.

8. The compressor modules and motors shall be fully isolated from the main compressor base by means of a four point, heavy-duty isolation system for a minimum of 95% isolation efficiency. Pumps not having this feature shall have an inertia base sized for that system installed at the contractor's expense.

Specifier, if seismic restraint is required, use this paragraph instead:

8. The compressor modules and motors shall be fully isolated from the main compressor base by means of a four point; heavy-duty seismic restrained Cal. OSHPD approved isolation system for a minimum of 95% isolation efficiency. Systems installed within Seismic Zones requiring seismic design for nonstructural components as outlined by ASCE 7-10, shall conform to certification as prescribed by ASCE 7-10, 13.2.2.1 or 13.2.2.2.

9. Provide redundant medical air treatment systems including desiccant dryers, filters, sized for peak calculated demand. Include dew point and carbon monoxide monitoring. Medical air treatment shall include:

   a. Desiccant dryers capable of producing a -40°C dew point and designed to reliably sustain a 10°F(-12°C) pressure dew point based upon the system SCFM capabilities.. Refrigerant dryers are not acceptable.

   b. Dryer purge flow control through an integral demand-based purge control system. Purge controllers using desiccant temperature are not acceptable.

   c. Mounted pre-filter rated for 0.01 micron with electric automatic drain and element change indicator at the inlet to each dryer.

   d. Final line filters rated for 0.01 micron with element change indicators, duplexed final line regulators, and duplexed safety relief valves shall be factory mounted and piped at the outlet of each dryer.

Self-contained desiccant cartridge with integral particulate filter.

10. Vibration flexes shall be all metal and of sufficient length to achieve full isolation. Systems using rubber tubing flex connectors with hose clamps are not acceptable. Systems with short flex connections providing only nominal isolation are not acceptable.

11. Provide corrosion resistant, ASME Coded, National Board Certified receiver rated for a minimum 200 PSIG design pressure. Include a liquid level glass, safety relief valve, manual drain valve, and a screened automatic solenoid valve. During normal operation the flow of air will travel through the tank to allow water vapor to condense in tank.

The Single Point Connection Systems (SPC) shall be a complete medical air package, pre-wired, pre-piped and assembled on one common base with single point connections(SPC) for electrical, intake air, discharge air, and condensate drains. All elements shall be factory installed including source valve. All piping shall be factory complete including all valves per NFPA 99 Fig. A-5.1.3.5.11.6.

Modular Systems shall be modules that make up a medical air package where the equipment's position is closely determined by the plans and specification and all interconnect piping, wiring, and power is supplied to each module by the installing contractor.

Specifier, select the paragraph below reflecting the preferred technology.

FOR SCROLL TECHNOLOGY

13. NFPA 99 Compliant Oil-less Scroll Medical Air Package:

    a. Capacity of multiple "Oil-less" scroll air compressor modules with inlet filter, isolation valve and high inlet vacuum switch for each

    b. Compressor to be a single stage scroll type, continuous duty rated with permanently lubricated, sealed bearings

    c. Compressor constructed of one fixed and one orbiting scroll sealed with PTFE tip seals between the scroll halves incorporating labyrinth lap design to minimize gap, maximize efficiency, and reliability.

    d. Air-cooled

    e. Rated for 120 psig discharge pressure

    f. Protected from dust or contamination with a two part face seal

    g. Orbiting bearings

    h. Drive Bearings - lip sealed bearings and tip seal replacement not needing maintenance before 10,000 hours of service.

    i. Drive bearing/tip seal replacement maintenance interval – 10,000 hours

    j. Scroll housing constructed of die cast aluminum

    k. Integral cooling fan and air ducting for maximum heat dissipation

    l. Air-cooled aftercoolers for each compressor module with maximum approach temperature of 15° F and automatic solenoid drain valves

m. V-belt drive with means of adjustment with fixed placement of pump and motor to insure alignment 15-20Hp systems should incorporating tensioning method independent of motor or pump placement Systems 10Hp and below utilizing pump or motor jacks as tensioning method are not acceptable.

n. High discharge air temperature shutdown switch wired to the compressor control system for each compressor

o. Discharge line valve for load-less starting

p. All discharge air piping and fittings - ASTM B-819 copper tubing, aluminum, brass and/or stainless steel

q. All brazed joints are per NFPA 99

r. All discharge flex connectors - braided, 304 stainless steel

s. Each compressor discharge line equipped with a safety relief valve, a check valve, isolation valve, and flex connector.

t. All components completely pre-piped and pre-wired to single point service connections

u. Liquid tight conduit, fittings and junction boxes for all control and power wiring

v. The complete medical air system and all electrical components shall be factory pre-tested prior to shipment by the MGEM.

FOR RECIPROCATING TECHNOLOGY

13. NFPA 99 Compliant Oil-less Reciprocating Medical Air Package:

a. Capacity of multiple "Oil-less" reciprocating air compressors with inlet filter and isolation valve on each compressor

b. Compressor to be a single stage reciprocating type, continuous duty rated with permanently lubricated, sealed bearings

c. Air-cooled

d. Corrosion resistant reed type valves with stainless steel reeds

e. Compression rings and rider rings - made from a long life, fluororesin material designed for continuous duty operation

f. Crankshaft constructed of a durable nodular graphite cast iron not aluminum

g. Crankcase shall be constructed of Cast Iron

h. Crankcase fully supported on both ends by heavy duty ball bearings permanently lubricated and sealed

i. Cast aluminum alloy cylinders treated for optimum corrosion and wear resistance assure maximum heat dissipation

j. Cylinder sleeves not required

k. Insulated "heat cut" piston pin minimizes heat transmission from the piston wall to the piston pin needle bearing.

l. Connecting rod - one-piece design for maximum reliability

m. V-belt drive with means of adjustment

n. High discharge air temperature shutdown switch on each individual pump head wired to the compressor control system for each compressor

o. Discharge line valve for load-less starting

p. Each compressor discharge line equipped with a safety relief valve, a check valve, isolation valve, and flex connector.

q. All discharge air piping and fittings - ASTM B-819 copper tubing, brass, aluminum, and/or stainless steel

r. All brazed joints are per NFPA 99

s. All discharge flex connectors - braided, 304 stainless steel, brass or bronze

t. All components completely pre-piped and pre-wired to single point service connections

u. Liquid tight conduit, fittings and junction boxes for all control and power wiring

v. The complete medical air system and all electrical components shall be factory pre-tested prior to shipment by the MGEM.

FOR ROTARY SCREW TECHNOLOGY

14. NFPA 99 Compliant "Oil-free" Rotary Screw Medical Air Package:

a. Modular base mounted design
b. Capacity of multiple air compressor modules
c. Dryer/Control module
d. Air receiver module
e. Compressor to be a positive displacement, two-stage rotary screw air compressor capable of delivering 100% oil-free air
f. No lubricants in the compression chamber
g. Fully packaged, including air compressor, main drive motor, oil cooler, intercooler and aftercooler, separate motor driven lubrication system, regulation and control systems
h. All components are mounted on a common base frame
i. Module is fully enclosed by a steel sound dampening enclosure. Noise level not to exceed 68 dB(A)

j. Compressor has two stages connected to an integral speed increaser
k. Each stage driven from a common bull gear to ensure optimum speed and high efficiency
l. Air-cooled intercooler between the first and second compression stages
m. Air-cooled aftercooler installed after the final stage
n. FDA approved rotor coating
o. Casing – Class 35 cast iron housing with precision manufactured, helical screw type rotors. The housing is air-cooled or optionally water cooled
p. Rotors & Shafts – One-piece SUS420 stainless steel construction, no internal rotor cooling required, asymmetric profile to ensure high efficiency, coated with $M0S_2$ for sealing clearances, dynamically balanced to guarantee vibration-free operation
q. Timing Gears – Manufactured of chromium molybdenum steel and fitted to the rotor shafts to maintain precise rotor-to-rotor clearance, designed to assist in thrust canceling and absorb no more than 10% of input power under full load
r. Bearings – Anti-friction bearings are incorporated on each rotor, radial loads are carried by straight roller bearings, axial loads are carried by two sets of angular contact ball bearings
s. Speed Increaser – An integral part of the compressor unit and includes the main drive shaft bull gear. The gear train is designed to be thrust canceling.
t. Seals – Restrictive ring type, stainless steel, dual vent seals offering 100% redundancy, self-adjusting and centering. The oil and air seal chambers are vented to atmosphere to prevent any possible contamination of the compressed air stream
u. Each seal is buffered by gas from the compression chamber which is purged to atmosphere ensuring that no lubricating oil or its vapor can enter the compression chamber to meet requirements of NFPA 99 5.1.3.5.4.1 (3)
v. Coolers – cross-flow aluminum construction and rated for 150 PSIG at 500 degrees F. operating conditions. The compressor cooling system is comprised of a separate motor driven fan and incorporates the following coolers:
    - Air-cooled oil cooler
    - Air-cooled intercooler complete with moisture separator and automatic drain.
    - Air-cooled aftercooler complete with moisture separator and automatic drain.
    - The cooling fan is driven by a separate motor, starting and stopping with the oil pump for maximum cooling during start-up and shutdown.
w. Lubrication System - Lubrication prior to start up, during operation and after shutdown is supplied by an independent motor driven gear pump. Compressor operation is not allowed until oil pressure is established.
x. During the coast down period the oil pump continues to provide full lubrication until the compressor stops.
y. Pressure Regulating System - Full load/no load type
z. Compressor unit control system is integral with the compressor package and consists of an electro-pneumatic regulator, designed to provide manual and automatic running. The capacity control valve is a disc type.
aa. Voltage is a maximum of 115 volts, 60 Hz. Provides automatic shutdown of the compressor during periods of excessive idling.
bb. Non-fused disconnect switch
cc. Control system is controlled and monitored Programmable Logic Controller (PLC). This controller initiates and sequences the events during start-up, operation, and shutdown. The PLC monitors system functions, safety devices, and instrumentation. The PLC incorporates an

Erasable Re-programmable Read Only Memory (EPROM) for permanent program storage. Control sequences can be changed on site. The control system will provide for the following:

- Automatic lead/lag control for 2-machine operation (NFPA requirement)
- Non-proprietary system components that do not require the equipment's owner to source replacement components to the Original Equipment Manufacturer (OEM) out of necessity.
- Lag in use alarm with isolated contacts for remote alarm (NFPA requirement)
- Auto restart after power failure (NFPA requirement)
- Start oil pump to ensure positive lubrication prior to start-up of the main drive motor.
- Start cooling fan when oil pressure is established.
- The compressor shall start unloaded and shall shut down unloaded, ensuring maximum component life.
- The oil pump shall continue to run until the compressor stops.
- Stop cooling fan motors 20 seconds after compressor is stopped to exhaust latent heat.
- Dry contacts are provided for remote indication of power failure or fault conditions and run indication.
- The control system shall provide automatic shut-off of the compressor if it remains unloaded for 10 minutes (to conserve energy) and shall automatically restart compressor on demand.
- Service indication shall be provided when it is time to perform routine maintenance.
- Shutdown indication shall occur with "first out" (first failure) feature when abnormal operating parameters are reached. Pre-alarms shall be required for all temperature shutdowns.
- Automatic restart following power failure
- Expandable to automatically start dryers, pumps, cooling tower, or other remote devices.

dd. Capable of recording time and day of last 100 alarms/events

ee. Operator interface is touch screen type with graphics, sunlight readable. Three configurable graphs for historical trending are standard.

ff. Minimum required devices:

- First-stage discharge air pressure display
- Second-stage discharge air pressure display
- Oil pressure display
- Air inlet filter service indicator
- Digital first-stage discharge air temperature display
- Digital second-stage air inlet temperature display
- Digital second-stage discharge temperature display
- Digital aftercooler outlet air temperature display
- Digital oil temperature display
- Low oil pressure indicator
- Running time display
- Loaded time display
- Standby light
- Power-on light
- Lag alarm light
- Motor overload indication

- Compressor run light
- Oil pump run light
- Fan run light
- Load light
- Manual unload button
- Oil level gauge
- Oil filter condition indicator
- Alarm buzzer
- Lamp test switch
- Buzzer cancel switch

gg. Safety Devices
- Capable of recording time and day of last 100 alarms/events.
- Automatic shut-off devices for the following conditions:
  + Low oil pressure
  + High outlet air pressure
  + High first-stage discharge air temperature
  + High second-stage inlet air temperature
  + High second-stage discharge air temperature
  + High outlet air temperature
  + High oil temperature
  + Compressor motor overload
  + Lube oil pump motor overload
  + Cooling fan motor overload
  + High cabinet temperature
  + Main starter failure

hh. The unit will automatically stop, annunciate by alarm bell, and indicate the appropriate failure by alarm and text display. Alarm bell will remain on until manually reset.

ii. Air intake filters are enclosed in the package and easily accessible for service. Air entering the compressor is drawn from outside the package.

jj. Air intake filters shall be paper cartridge type of 5 micron - 99% or greater efficiency

kk. The compressor unit, including motor, is enclosed in a steel sound insulating canopy with removable doors to provide ready access for normal maintenance.

ll. Sound insulating material shall be nominal 2 pounds per cubic foot polyether foam with UL94HP-1 flame resistance. Sound insulating material shall be 1 inch thick.

mm. Enclosure shall be ventilated using a separate motor driven fan starting when oil pressure is established and stopping 20 seconds after the compressor stops

nn. Enclosure is equipped with an inlet air adapter for piping intake to outside of facility as per NFPA 99 code

oo. No special foundations are required other than those necessary to support the weight of the unit. The unit is delivered with all internal compressed air and oil piping, and wiring complete. There is a 2-source hook-up for utilities, one for air discharge and one for incoming electrical service. All automatic drain lines are brought out of the cabinet for ease in connecting to floor drain.

pp. The complete medical air system and all electrical components shall be factory pretested prior to shipment by the MGEM.

FOR RECIPROCATING INSTRUMENT AIR TECHNOLOGY

15. NFPA 99 Compliant Oil Flooded Reciprocating Medical Instrument Air Package:

    a. Capacity of multiple reciprocating air compressors with inlet filter and isolation valve on each compressor capable of producing up to 200psi

    b. Compressor to be a two stage reciprocating type, continuous duty rated

    c. Air-cooled

    d. Crankshaft constructed of a durable nodular graphite cast iron not aluminum

    e. Crankcase fully supported on both ends by heavy duty ball bearings permanently lubricated and sealed

    f. Cast aluminum alloy cylinders treated for optimum corrosion and wear resistance assure maximum heat dissipation

    g. Cylinder sleeves not required

    h. Insulated "heat cut" piston pin minimizes heat transmission from the piston wall to the piston pin needle bearing.

    i. Connecting rod - one-piece design for maximum reliability

    j. V-belt drive with means of adjustment

    k. High discharge air temperature shutdown switch wired to the compressor control system for each compressor head discharge

    l. Discharge line valve for load-less starting

    m. Each compressor discharge line equipped with a safety relief valve, a check valve, isolation valve, and flex connector.

    n. All discharge air piping and fittings - ASTM B-819 copper tubing, brass, aluminum, and/or stainless steel

    o. All brazed joints are per NFPA 99

    p. All discharge flex connectors - braided, 304 stainless steel, brass or bronze

    q. All components completely pre-piped and pre-wired to single point service connections

    r. Liquid tight conduit, fittings and junction boxes for all control and power wiring

    s. The complete medical air system and all electrical components shall be factory pre-tested prior to shipment by the MGEM.

PART 3.0 - EXECUTION

3.1 INSTALLATION

Bases and Site preparation

1. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA99.
2. Equipment Mounting: Install vacuum producers on concrete bases. Contractor shall furnish 4 inch high concrete housekeeping pads under all medical air, instrument air, vacuum and WAGD plant in this section. Comply with requirements in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration and Seismic Controls for “Plumbing Piping and Equipment."
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Contractor shall furnish inertia bases in lieu of housekeeping pads where the equipment installed is not factory isolated by the manufacturer.
6. Cast anchor bolts into bases.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Install vacuum equipment anchored to substrate.
9. Orient equipment so controls and devices are accessible for servicing.
10. Maintain manufacturers recommended clearances for service and maintenance.

3.1

3.2

A.

B.

VACUUM EQUIPMENT INSTALLATION

Install vacuum equipment for healthcare facilities according to ASSE 60 I 0 and NFPA 99.

Equipment Mounting: Install vacuum producers on concrete bases. Comply with requirements in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

2.· For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams,

instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install vacuum equipment anchored to substrate.

D. Orient equipment so controls and devices are accessible for servicing.

E. Maintain manufacturers recommended clearances for service and maintenance.

Pipe work

1. All installation shall be performed in strict accordance with NFPA 99 5.1.10. Brazing procedures shall be as detailed in NFPA 99 5.1.10.5. Brazing shall be performed only by braziers qualified under NFPA 99 5.1.10.10.11.

2. Where piping runs underground, install in accordance with NFPA 99 5.1.10.10.5.

3. Copper, tubing, valves and fittings shall be pre cleaned and prepared for oxygen service by the manufacturer and received sealed on the job. Certificates of origin and of proper preparation shall be maintained on the job site attesting the above.

4. The use of flux is prohibited when making of joints between copper to copper pipes and fittings.

5. During any brazing operation, the interior of the pipe shall be purged continuously with oil free, dry nitrogen NF, following the procedure in NFPA 99 5.1.10.5.5. At the completion of any section, all open pipe ends shall be capped using an EXTERNAL cap.

6. Threaded joints in piping systems shall be avoided whenever possible. Where unavoidable, make up the male threads with polytetrafluorofethylene (such as Teflon) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only.

7. Piping shall be supported with pipe trays or hangers at intervals as shown on the drawings or as defined in NFPA 99 Table 5.1.10.10.4.5. Piping shall not be supported by other piping. Isolation of copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as an isolation material.

8. After installation of the piping, but before installation of the outlet valves, blow lines clear using nitrogen NF.

9. Piping exposed to physical damage shall be protected.

10. Label piping with name of gas service, identification color and direction of flow. Where non-standard pressures are piped, label for pressure. Labels shall be placed at least once every 20 feet of linear run or once in each story (whichever is more frequent). A label shall additionally be placed immediately on each side of each wall or floor penetration. Pipe labels shall be self adhesive vinyl or other water resistant material with permanent adhesive colored in accordance with NFPA 99 Table 5.1.11 and shall be visible on all sides of the pipe. Pipe labels shall be Patton' Medical #25-04-0xx Series of Piping Labels.

11. Alarms and valves shall be labeled for gas service and areas monitored or controlled. Coordinate with owner for final room or area designations. Label valves with name and identification color of the gas and direction of flow.

12. Piping penetrating an electromagnetic shield shall have an isolation device on each side of shield.

Labeling

1. Label the medical gas pipelines per NFPA 99 5.1.11 and as follows:

    a. Label each master alarm signal for function after ring out.

    b. Label each zone valve and area alarm for the area of control or surveillance after test.

2. Labels shall be permanent and of a type approved by the owner.

3.2 INSTALLER TESTING

A. Prior to declaring the lines ready for final verification, the installing contractor shall follow strictly the procedures for verification as described in NFPA 99 5.1.12.2 and attest in writing over the notarized signature of an officer of the installing company the following;

1. That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.

2. That all brazing was conducted with nitrogen purging. (Procedure per NFPA 99 5.1.10.5.5).

3. That the lines have been blown clear of any construction debris using oil free dry nitrogen or air are clean and ready for use. (Procedure per NFPA 99 5.1.12.2.2).

4. That the assembled piping, prior to the installation of any devices, maintained a test pressure 1 1/2 times the standard pressures listed in NFPA 99 Table 5.1.11 without leaks. (Procedure per NFPA 99 5.1.12.2.3).

5. That after installation of all devices, the pipeline was proven leak free for 24 hours at a pressure 20% above the standard pressures listed in NFPA 99 Table 5.1.11. (Procedure per NFPA 99 5.1.12.2.2.6)

6. That the systems have been checked for cross connections and none were found. (Procedure per NFPA 99 5.1.12.2.4)

7. That the manufacturer has started up all medical air compressors, medical vacuum pumps WAGD producers, liquid oxygen system(s) and manifolds, and that they are in operating order.

B. Provide four originals of the affidavit, distributed; (1) to the engineer, (1) to the owners representative, (1) to the general contractor and (1) to the verifier.

3.3 VERIFIER TESTING

A. Prior to handing over the systems to the owner, contractor shall retain a Verifier acceptable to the engineer and owner who shall follow strictly the procedures for verification as described in NFPA 99 5.1.12.3 and provide a written report and certificate bearing the notarized signature of an officer of the verification company which contains at least the following:

1. A current ACORD insurance certificate indicating professional liability coverage in the minimum amount of $1 Million per occurrence, and general aggregate liability in the minimum amount of $1 Million, valid and in force when the project is to be verified. General liability insurance is not alone acceptable.

2. An affidavit bearing the notarized signature of an officer of the verification company stating that the verification company is not the supplier of any equipment used on this project or tested in this report and that the verification contractor has no relationship to, or pecuniary interest in, the manufacturer, seller, or installer of any equipment used on this project or tested in this report

3. A listing of all tests performed, listing each source, outlet, valve and alarm included in the testing.

4. An assertion that all tests were performed by a MGPHO Certified Medical Gas Verifier (CMGV) or by individuals qualified to perform the work and holding valid qualifications to ASSE 6030 and under the immediate supervision a CMGV Verifier. Include the names, credential numbers and expiration dates for all individuals working on the project.

5. A statement that equipment used was calibrated at least within the last six months by a method traceable to a National Bureau of Standard Reference and enclosing certificates or other evidence of such calibration(s). Where outside laboratories are used in lieu of onsite equipment, those laboratories shall be named and their original reports enclosed.

6. A statement that where and when needed, equipment was re-calibrated during the verification process and describing the method(s) used.

7. A statement that the systems were tested and found to be free of debris to a procedure per NFPA 99 5.1.12.3.7.

8. The flow from each outlet when tested to a procedure per NFPA 99-5.1.12.3.10.

9. A statement that the systems were tested and found to have no cross-connections to a procedure per NFPA 99 5.1.12.3.3.

10. A statement that the systems were tested and found to be free of contaminants to a procedure per NFPA 99 5.1.12.3.8 except that the purity standard shall be 2 ppm difference for halogenated hydrocarbons and 1 ppm total hydrocarbons (as methane).

11. A statement that all local signals function as required under NFPA 99 5.1.3.4.7 and as per the relevant NFPA 99 sections relating to the sources.

12. A listing of local alarms, their function and activation per NFPA 99 5.1.12.3.14.

13. A listing of master alarms, their function and activation, including pressures for high and low alarms per NFPA 99 5.1.12.3.5.2.

14. A listing of area alarms, their function and activation pressures per NFPA 99 5.1.12.3.5.3.

15. A statement that the sources include all alarms required by NFPA 99 Table A.5.1.9.5.

16. The concentration of each component of NFPA 99 Table 5.1.12.3.12 in the medical air after 24 hours of operation of the medical air source.

17. The concentration of each gas at each outlet as specified in NFPA 99 5.1.12.3.11.

18. A statement that all valves and alarms are accurately labeled as to zone of control.

B. Provide four originals of this affidavit, and report, distributed; (1) to the engineer, (1) to the owner's representative, (1) to the general contractor and (1) to the installing contractor.

END OF SECTION