2016 Medical Gas
Cylinder Storage, Piping & Alarms System Reminder List

Applicable Codes and Standards
CBC 2016, CEC 2016, CFC 2016
NFPA 55 2016, NFPA 99 2015

I. APPLICABILITY
1. The design, installation and testing of medical gas and vacuum systems shall conform to Table 1224.4.6.1 and NFPA 99-2015, Standard for Health Care Facilities.

2. The performance, installation and testing of Category 1 piped medical gas and vacuum systems shall be in accordance with Section 5.1 of NFPA 99, 2015 edition. Wherever the terms medical gas or vacuum occur, the provisions of Section 5.1 apply to all piped systems for oxygen, nitrous oxide, medical air, carbon dioxide, helium, medical-surgical vacuum, waste anesthetic gas disposal, and mixtures thereof. Wherever the name of a specific gas or vacuum occurs, the provision applies only to that gas.

3. The installation of bulk oxygen systems in excess of 20,000 cu. ft. shall be in accordance with NFPA 55, 2016 edition.

4. Storage of compressed medical gas cylinders shall be in accordance with Chapter 50 of the California Fire Code and NFPA 99, Sec. 11.3 when such storage quantity is 504 cu. ft. or greater but less than 3,000 cu. ft..

5. Rooms or areas where medical gases are stored or used in quantities exceeding the maximum allowable quantity per control area as set forth in Section 5003.1 shall be in accordance with the California Building Code for high-hazard Group H occupancies.

II. MEDICAL GAS STORAGE & SYSTEM SOURCE LOCATIONS

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1. Medical gases shall be stored in areas dedicated to the storage of such gases without other storage or uses.

2. Medical gases in quantities greater 504 cu. ft. located inside buildings shall be in a one-hour exterior/interior room or gas cabinet.

3. A one-hour exterior room shall be a room or enclosure separated from the remainder of the building by fire barriers with a fire-resistance rating of not less than 1 hour. Openings between the room or enclosure and interior spaces shall be self-closing smoke-and draft-control assemblies having a fire-protection rating of not less than one hour. Rooms shall have at least one exterior wall that is provided with not less than two nonclosable louvered vents. Each vent shall not be less than 24 square inches for each 1,000 cubic feet at normal temperature and pressure of gas stored in the room and shall be not less than 72 square inches in aggregate free opening area; one vent shall be within 6 inches of the floor and one shall be within 6 inches of the ceiling. Rooms shall be provided with at least one fire sprinkler to provide container cooling in case of fire.
4. When an exterior wall cannot be provided for the room, automatic sprinklers shall be installed within the room. The room shall be exhausted through a duct to the exterior. Supply and exhaust ducts shall be enclosed in a 1-hour-rated shaft enclosure from the room to the exterior. Approved mechanical ventilation shall comply with the California Mechanical Code and be provided at a minimum rate of 1 cfm per sq. ft. of the area of the room. CFC, Sec. 5306.2.2

5. Gas cabinets shall be constructed in accordance with CFC, Section 5003.8.6 and shall have an average velocity of ventilation at access ports or windows of at least 200 fpm with a minimum of 150 fpm at any point of the access port or window, be connected to an exhaust system and shall be internally sprinklered. CFC, Sec. 5306.2.3

6. Medical gas cylinders containing more than 504 cu. ft. of oxidizers located on the exterior of a building shall be in accordance with CFC, Section 6304.2.1. CFC, Sec. 5306.3

7. When located indoors, locations for central supply systems and the storage of positive pressure (compressed) gases shall be noncombustible or limited combustible materials of not less than 1-hour fire-resistance rating with protected openings. NFPA 99, Sec. 5.1.3.3.2(5)& (6)

8. When located outdoors, locations for central supply systems and the storage of positive pressure (compressed) gases shall be located in an enclosure (wall or fencing) constructed of noncombustible materials with a minimum of two entry/exits. NFPA 99, Sec. 5.1.3.3.2(3)

9. Locations for central supply systems and the storage of positive pressure (compressed) gases shall be secured with lockable doors or gates or otherwise secured. NFPA 99, Sec. 5.1.3.3.2(2)

10. No cylinders containing flammable gases, or containers containing flammable liquids shall be stored in rooms containing medical gas cylinders. NFPA 99, Sec. 5.1.3.2.4

11. Provisions shall be made for racks, chains or other fasteners to protect cylinders from falling. NFPA 99, Sec. 5.1.3.3.2(9)

12. Electric wall fixtures, switches, receptacles, etc. shall be protected, located to avoid damage from cylinders or located at least 5 ft. above the floor. NFPA 99, Sec. 5.1.3.3.2(7)

13. Medical air compressors and vacuum pumps shall be located separately from cylinder storage locations. NFPA 99, Sec. 5.1.3.3.1.4

14. Full or empty medical gas cylinders, when not connected, shall be stored in locations complying with the requirements for a central supply location and shall be permitted to be in the same rooms or enclosures as their respective central supply systems. NFPA 99, Sec. 5.1.3.3.4.1

15. Source locations containing compressors shall be ventilated to prevent the accumulation of heat. (medical air, medical-surgical vacuum, waste anesthetic gas disposal and instrument air sources). NFPA 99, Sec. 5.1.3.3.3

16. Relief valves shall be vented to the exterior. Compressed air excepted. NFPA 99, Sec. 5.1.3.3.3.2
17. Where natural ventilation cannot be provided, mechanical ventilation shall be provided. Mechanical exhaust to maintain a negative pressure in the space shall be provided continuously.

III. PIiped MEDICAL Gas SYSTEMS - SUPPLY

1. Patient medical gas systems shall conform to the requirements for Category 1 gas systems.

2. Task illumination and receptacles provided at the medical gas supply location which are needed for effective hospital operation shall be connected to the critical branch of the essential electrical system.

3. Indoor central supply locations for oxygen, nitrous oxide and mixtures of these gases shall not communicate with critical patient care areas, anesthetizing locations, locations storing flammables, rooms containing open electrical contacts or transformers, storage tanks for flammable or combustible liquids, engines, kitchens or areas with open flames.

4. Medical gas central supply systems shall not be piped only into areas where gases will be used under the direction of licensed medical professionals including: direct respiration of patients, clinical application, medical device applications directly related to respiration, power for medical devices used directly on patients and calibration of medical devices intended for such uses.

5. Central supply systems for support gases (nitrogen and instrument air) shall not be piped to or used for any purpose except medical support application.

6. Central supply systems shall have duplex final pressure regulators installed in parallel, with isolation valves before each regulator and an isolation/check valve after each regulator.

7. A manual shut-off valve shall be installed before each central supply system final pressure regulator.

8. A manual shut-off valve or check valve shall be installed after each central supply system final pressure regulator.

9. A pressure relief valve shall be installed between each final pressure regulator and before the source valve.

10. A pressure relief valve shall be installed in the main line set at 50% above normal line pressure.

11. Pressure relief valves shall vent to the exterior except that relief valves for compressed air systems having a capacity of less than 3,000 cu. ft. are permitted to be diffused locally by a means that will not restrict flow.
12. When vented to the exterior, relief valve discharge lines shall be of the same materials and construction as distribution lines. 
13. When vented to the exterior, relief valve discharge lines shall be labeled in accordance with Section 5.1.11.1. 
14. Vent discharge terminal shall be turned down and screened to prevent the entry of rain, snow or vermin. 
15. The relief valve vent discharge shall not be smaller than the size of the relief valve outlet. 
16. Where two or more relief valves discharge into a common vent line, the internal cross-sectional area shall be not less than the aggregate cross-sectional area of all vent discharge lines served.

IV. SUPPLY MANIFOLD SYSTEMS

1. Each header shall be provided with a shutoff valve downstream from the nearest cylinder connection but upstream of the point where the header connects to the central supply system.

2. Each header shall be provided with a filter to prevent the intrusion of debris into the manifold controls.

3. Each header shall be provided with a pressure gauge.
4. Each header shall be provided with a check valve to prevent backflow into the header and to permit service to the header.

5. Each gas cylinder header shall be provided with a check valve at each gas cylinder connection.

6. Each gas cylinder header shall be provided with a pressure regulator to reduce the cylinder pressure for proper operation of the system.

7. Each cryogenic liquid container header shall be provided with a pressure relief valve.

8. Vent valves if provided, shall vent to the exterior.

9. Each manifold system using gas cylinders shall include two equal headers, each with a sufficient number of cylinder connections for an average day's supply.

10. Each manifold system using gas cylinders shall include an intermediate relief valve piped to the exterior located between the header pressure regulator and the line pressure regulator assembly to protect the line pressure regulators in the event of a header regulator failure.

11. Vent valves if provided, shall vent to the exterior.

12. Manifolds with two headers shall actuate a local signal and an indicator at all master alarm panels when changeover has occurred or is about to occur.

13. Manifolds with a reserve supply are required for gas cylinder systems when an emergency oxygen supply connection is not provided and for all cryogenic liquid container manifold systems.

14. The reserve header is permitted to be located in the same enclosure with the primary and secondary headers or in another enclosure.

15. The reserve header shall have sufficient number of cylinders for an average day's supply.

16. The reserve header shall include a check valve in the main line placed on the distribution system side of the ordinary source's main line valve to prevent flow from the reserve to the ordinary source.

17. The system shall automatically activate the reserve header if the primary and the secondary headers cannot supply the system.

18. Manifolds with a reserve header shall actuate a local signal and an indicator at all master alarm panels before changeover to the secondary header occurs, before the reserve header begins to supply the system and when the reserve supply falls to one day's supply.

V. CRYOGENIC MANIFOLD SYSTEMS

1. Cryogenic manifolds shall include two equal headers, each having sufficient number of liquid containers for an average day's supply and a reserve header having sufficient number of gas cylinders for an average day's supply.
2. Cryogenic manifolds shall have a pressure relief valve installed downstream of the reserve header and upstream of the final line pressure regulating assembly and set at 50% above the nominal inlet pressure.  
   **NFPA 99, Sec. 5.1.3.5.12.4(3)**

3. Cryogenic manifolds shall be provided with two liquid container headers, either capable of functioning as the primary or secondary header or one primary liquid container header and one secondary gas cylinder header.  
   **NFPA 99, Sec. 5.1.3.5.12.5(1) & (2)**

4. Cryogenic manifolds shall be provided with an economizer that shall discharge conserved gas upstream of the final line regulator assembly.  
   **NFPA 99, Sec. 5.1.3.5.12.6**

5. Cryogenic manifolds shall include a manual or automatic means to place either header into the role of primary header and the other in the role of the secondary header, except where a liquid/gas hybrid manifold is used.  
   **NFPA 99, Sec. 5.1.3.5.12.7**

6. The system shall automatically activate the reserve header if the primary and the secondary headers cannot supply the system.  
   **NFPA 99, Sec. 5.1.3.5.12.8**

7. Manifolds with a reserve header shall actuate a local signal and an indicator at all master alarm panels before changeover to the secondary header occurs, before the reserve header begins to supply the system and when the reserve supply falls to one day's supply.  
   **NFPA 99, Sec. 5.1.3.5.12.9**

8. Hybrid liquid/gas manifolds shall actuate a local signal and an indicator at all master alarm panels before the secondary (gas) header supply falls to one day's supply.  
   **NFPA 99, Sec. 5.1.3.5.12.9**

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**VI. PIPED MEDICAL GAS SYSTEMS – ALARMS**

1. All local, master, and area medical gas alarm panels shall provide: (1) separate visual indication for each condition monitored, (2) visual indicators that remain in alarm until the situation is resolved, (3) cancelable audible indication of alarm condition, and (4) a visual means to check or indicate LED or lamp failure.  
   **NFPA 99, Sec. 5.1.9.1 (1), (2), (3) & (4)**

2. Local, master and area medical gas alarms shall indicate a visual and audible signal if the monitored condition occurs or if wiring to the sensor switch is disconnected.  
   **NFPA 99, Sec. 5.1.9.1(5)**

3. The audible indication of medical gas alarm panels shall produce a minimum of 80dBA measured at 3 ft. from the alarm.  
   **NFPA 99, Sec. 5.1.9.1(3)**

4. A second indicated condition occurring while a medical gas alarm panel is silenced shall cause the audible signal to reinitiate.  
   **NFPA 99, Sec. 5.1.9.1(8)**

5. Medical gas alarms shall be labeled to indicate the type of gas they serve and the room(s) or area(s) they serve.  
   **NFPA 99, Sec. 5.1.9.1(6) & (7)**

6. Master alarms shall be connected by dedicated wiring directly to the sensors or switches.  
   **NFPA 99, Sec. 5.1.9.2.3**

7. A master medical gas alarm panel shall be provided to monitor the operation and condition of the source of supply and the reserve, and the pressure of the medical gas piping system.  
   **NFPA 99, Sec. 5.1.9.2**

8. One of the two required master medical gas alarm panels shall be located in the principal working area of the individual responsible for maintenance of the medical gas system.  
   **NFPA 99, Sec. 5.1.9.2.1(1)**
9. One of the two required master medical gas alarm panels shall be located to assure continuous surveillance during the operating hours of the facility (e.g. telephone switchboard, security office, nurse station, or other continuously staffed location).

10. A centralized computer system shall be permitted to be substituted for one of the required master alarms.

11. Local, master and area medical gas alarms shall be powered by the Life Safety Branch of the Emergency Power System.

12. All wiring to pressure switches and sensors shall be supervised or in conduit, free air, wire, cable tray or raceways.

13. Communication that does not use electrical wiring for signal transmission shall be supervised such that failure shall initiate an alarm.

14. Provisions for automatic restart after power loss of 10 seconds without false signals or requiring manual restart.

15. All pressure switches and sensors shall be provided with a gas specific demand check fitting to facilitate service, testing and replacement except zone valve gauges.

16. Demand check valves shall be provided for all monitors.

17. A master medical gas alarm panel shall provide a visual and audible indication for each of the following conditions: (1) bulk system changeover (manifold or alternating-type), (2) bulk cryogenic liquid system reaches an average day's supply, (3) reserve in use, (4) cylinder reserve quantity low, (5) cryogenic liquid system reserve is low, (6) cryogenic liquid storage unit used as reserve for bulk system is low, (7) low or high line pressure (20% above or below normal operating pressure), (8) vacuum pressure in main vacuum line drops to or below 12 in., (9) alarm indications from source equipment local alarm panels, (10) medical air dew point high alarm, (11) WAGD low alarm, (12) instrument air dew point high alarm and (13) when the primary or reserve production stops on a proportioning system.

18. A medical gas area alarm shall be provided for each piping system supplying anesthetizing locations where moderate sedation, deep sedation, or general anesthesia is administered and critical care areas, such as postanesthesia recovery, intensive care units, coronary care units, emergency departments, etc.

19. Area alarm panels shall be located at a nurse’s station or other location that will provide for responsible surveillance.

20. Area alarms shall indicate if the pressure in the local line increases or decreases 20% from normal pressure.

21. Area alarms for medical-surgical vacuum shall indicate a drop in vacuum pressure to or below 12 in.
22. Sensors for area alarms for vital life support and critical care areas shall be located on the patient or use side of any individual zone box assemblies.

23. Sensors for area alarms for anesthetizing locations where moderate sedation, deep sedation or general anesthesia is administered shall be located either on the source side of individual room zone box assemblies or on the patient use side of individual zone valve assemblies.

24. Computer systems used to substitute for alarms shall be in continuous uninterrupted operation with power supplies as needed to ensure such reliability.

25. Computer systems used to substitute for alarms shall be continuously attended by responsible individuals or provide remote signaling of responsible parties (e.g., pagers, auto dialers, or other such means).

26. Where computer systems used to substitute for alarms rely on signal interface devices (e.g., electronic interfaces, other alarm panels, 4-20 mA cards, etc.), such interfaces shall be supervised such that failure shall initiate an alarm.

27. If the computer does not power the signaling switches/sensors, the power supply for the switches/sensors shall be from the life safety branch of the emergency electrical system.

28. Computer systems shall be permitted to connect directly to the sensors/switches in the same manner as an alarm panel if operation of other alarm panels is not impaired.

29. Wiring from computer systems to signaling switches/sensors shall be supervised or in conduit or raceways.

30. Computer systems shall be provided with an audio alert.

31. Operating systems for computer systems used as a substitute for master alarms shall allocate medical gas alarms the priority of a life safety signal.

32. A medical gas alarm signal shall interrupt any other activity of lesser priority to run the alarm algorithm(s).

33. The alarm algorithm shall activate an audible alert, any remote signaling protocol and display the specific alarm condition.

34. The alarm algorithm shall provide (1) separate visual indication for each condition monitored, (2) visual indicators that remain in alarm until the situation is resolved, (3) cancelable audible indication of alarm condition, (4) indicate a visual and audible signal if the monitored condition occurs or if wiring to the sensor switch is disconnected, (5) labels to indicate the type of gas they serve and the room(s) or area(s) they serve and (6) reinitiation of the audible signal if a second indicated condition occurs while a medical gas alarm panel is silenced.

35. Local alarms shall be installed to monitor functions of air compressor system(s), medical-surgical vacuum pump system(s), WAGD system(s) and instrument air system(s).

36. Local alarm signals are permitted to be located on or in the machinery control panel, within a monitoring device or on a separate alarm panel.
37. The master alarm panel shall include at least one signal from source equipment to indicate a problem with the source equipment. The master alarm signal shall activate when any local alarm signal activates.

38. Where there is more than one medical air compressor system, instrument air compressor system, WAGD system, or more than one medical-surgical vacuum pump system at different locations in the facility, or if the compressors or vacuum pumps are at different locations in the facility, it shall be necessary for each location to have separate alarms at master panels.

39. A local alarm shall monitor when a backup or lag compressor is in operation except when a medical air system consists of three or more compressors in which case the alarm shall activate when the last compressor is signaled to start.

40. A local alarm shall monitor high carbon monoxide level in the medical air system is 10 ppm or higher.

41. A local alarm shall monitor high medical air dew point greater than +2°C (+35°F)

42. A local alarm shall monitor when a backup or lag vacuum pump is in operation except when a vacuum pump system consists of three or more pumps in which case the alarm shall activate when the last pump is signaled to start.

43. A local alarm shall monitor when a WAGD lag is in use. The signal shall be manually reset.

44. A local alarm shall monitor high instrument air dew point greater than greater than -30°C (-22°F).

45. A local alarm shall monitor water level in the receiver tank of compressor systems using liquid ring or water cooled compressors.

46. A local alarm shall monitor water level in separators of compressor systems using liquid ring compressors.

47. A local alarm shall monitor discharge air temperature for compressor systems using other than liquid ring compressors.

48. Proportioning systems high/low indicator when the oxygen concentration is outside 19.5 % to 23.5% oxygen.

49. Proportioning system reserve in operation.

VII. PIPED MEDICAL GAS SYSTEMS – SHUTOFF VALVES

1. Zone valves shall be installed in valve boxes with removable covers large enough to allow manual operation of valves and shall be permitted to be secured to prevent inappropriate access.

2. A source valve shall be placed at the immediate connection of each source system to the piped distribution system to permit the entire source of supply, including all accessory devices, to be isolated from the facility. The source valve shall be located in the immediate vicinity of the source equipment.

3. A source valve shall be labeled “SOURCE VALVE FOR THE (SOURCE NAME)."

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NFPA 99, Sec. 5.1.9.5.2

NFPA 99, Sec. 5.1.9.5.3

NFPA 99, Sec. 5.1.9.5.4(1)

NFPA 99, Sec. 5.1.9.5.4(2)

NFPA 99, Sec. 5.1.9.5.4(3)

NFPA 99, Sec. 5.1.9.5.4(4)

NFPA 99, Sec. 5.1.9.5.4(5)

NFPA 99, Sec. 5.1.9.5.4(6)

NFPA 99, Sec. 5.1.9.5.4(7)

NFPA 99, Sec. 5.1.9.5.4(8)

NFPA 99, Sec. 5.1.9.5.4(9)

NFPA 99, Sec. 5.1.9.5.4(10)

NFPA 99, Sec. 5.1.9.5.4(11)

NFPA 99, Sec. 5.1.4.1.4 (A) & (B)

NFPA 99, Sec. 5.1.4.2.1 & Sec. 5.1.4.2.2

NFPA 99, Sec. 5.1.11.2.3
4. The main supply line shall be provided with a shutoff valve inside of the building except where the source and source valve are located in the building served or the source system is physically mounted to the wall of the building in the immediate vicinity of the source valve. NFPA 99,
Sec. 5.1.4.3.1

5. The main supply line shutoff valve shall be located to permit access by authorized personnel only (i.e., above a ceiling, a secured area, locked or latched in their operating position). NFPA 99,
Sec. 5.1.4.1.2

6. The main supply line shutoff valve shall be located on the facility side of the source valve and outside of the source room, enclosure, or where the main line first enters the building. NFPA 99,
Sec. 5.1.4.3.2

7. The main valve shall be identified "MAIN LINE VALVE FOR THE (GAS/VACUUM NAME) SERVING THE (NAME OF THE BUILDING)"

8. Each riser supplied from the main line shall be provided with a shutoff valve adjacent to the main line. NFPA 99,
Sec. 5.1.11.1

9. Riser valves shall be permitted to be located above ceilings but shall remain accessible (authorized personnel) and shall not be obstructed. NFPA 99,
Sec. 5.1.11.2

10. A riser valve shall be labeled "RISER FOR THE (GAS/VACUUM NAME) SERVING (NAME OF AREA/BUILDING SERVED BY THE PARTICULAR RISER)"

11. Service valves shall be installed to allow servicing or modification of lateral branch piping from a main line or a riser without shutting down the entire main, riser or facility. NFPA 99,
Sec. 5.1.4.5.1

12. Only one service valve shall be required for each branch off a riser regardless of the number of zone valves installed on the lateral. NFPA 99,
Sec. 5.1.4.5.2

13. Service valves shall be placed in branch piping prior to any zone valve box on the branch line. NFPA 99,
Sec. 5.1.4.5.3

14. Service valves shall be located behind a locked access door, locked open above a ceiling or locked open in a secured area. NFPA 99,
Sec. 5.1.4.1.2

15. Service valves shall be labeled "SERVICE VALVE FOR (GAS/VACUUM NAME) SERVING (NAME OF THE AREA/BUILDING SERVED BY THE PARTICULAR VALVE)"

16. Station outlets/inlets shall not be supplied directly from a riser unless a manual shutoff valve (zone valve) is installed between the riser and the outlets/inlets with a wall intervening between the valve and the outlets/inlets. NFPA 99,
Sec. 5.1.4.6.1(1)

17. A zone valve shall serve only outlets/inlets located on the same story. NFPA 99,
Sec. 5.1.4.6.1(2)

18. A zone valve shall not be located in a room with station outlets/inlets that it controls. NFPA 99,
Sec. 5.1.4.6.1(3)

19. A zone valve shall be readily operable from a standing position in the corridor on the same floor they serve. NFPA 99,
Sec. 5.1.4.6.2

20. A zone valve is permitted to be located at a nurse station within a suite when the suite is subdivided by walls. NFPA 99,
Sec. 5.1.4.6.1(1)

21. A pressure/vacuum gauge shall be provided on the station outlet/inlet side of each zone valve.

NFPA 99,
Sec. 5.1.4.6.4
22. A zone valve shall be so arranged that shutting off the supply of medical gas to one zone will not affect the supply of medical gas to another zone or the rest of the system.

23. A zone valve shall be located immediately outside each vital life-support, critical care and anesthetizing location of moderate sedation, deep sedation or general anesthesia in each medical gas and/or vacuum line, and located so as to be readily accessible in an emergency.

24. Zone valves shall not be located in closed or locked rooms, areas or closets.

25. All gas-delivery columns, hose reels, ceiling tracks, control panels, pendants, booms, or other special installations shall be located downstream of the zone valve.

26. Zone valves shall be so arranged that shutting off the supply of gas to any one operating room or anesthetizing location will not affect others.

27. Zone valves shall be installed where they are visible and accessible at all times. Zone valves and shutoff valves (manual) shall not be installed behind normally open or normally closed doors, or otherwise hidden from plain view.

28. Optional in-line valves shall be permitted to be installed to isolate or shut off piping for servicing of individual rooms or areas.

29. In-line valves shall be located in a restricted area and shall be locked or latched open.

30. In-line valves shall be identified "SERVICE VALVE FOR (GAS/VACUUM NAME) SERVING (NAME OF THE AREA/BUILDING SERVED BY THE PARTICULAR VALVE)"

31. All shutoff valves shall be identified with the name or chemical symbol for the specific system, the room or area served and a caution to not close or open valve except in an emergency.

32. When positive pressure gas systems operate at a pressure other than 50 psi to 55 psi or a pressure of 160 psi to 185 psi for nitrogen or instrument air, the valve identification shall also include the nonstandard operating pressure.

VIII. PIPED MEDICAL GAS SYSTEMS — DISTRIBUTION

1. Tubes, valves, fittings, station outlets and other piping components in medical gas systems shall have been cleaned for oxygen service by the manufacturer prior to installation, except that fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer.

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

3. Fittings, valves and other components shall be delivered sealed, labeled and kept sealed until prepared for installation.

4. Piping shall be hard-drawn seamless copper ASTM B 819 for medical gas service and each length of tubing shall be permanently labeled Type K or L and bear one of the following markings: OXY, MED, OXY/MED, ACR/OXY, or ACR/MED, in blue for Type L and green for Type K.
5. For piping for systems operated above 185 psi, Type K copper shall be used for sizes larger than DN80 (NPS 3) (3-1/8 in. O.D.).

6. Piping for vacuum systems shall be hard-drawn seamless cooper tube ASTM B 88, (Types K, L, M) or ASTM B 280 copper ACR tube or ASTM B 819, copper medical gas tubing (Type K or L) or stainless steel tube.

7. Where copper vacuum tubing is installed along with any medical gas tubing, the vacuum tubing shall be prominently labeled prior to installation.

8. Where medical gas tubing (ASTM B 819) is used for vacuum piping, special marking prior to installation is not required, provided that the vacuum piping installation meets all the requirements for medical gas piping including prohibition of flux on copper-to-copper joints and provide for the use of a nitrogen purge while brazing.

9. WAGD systems shall be piped using materials permitted for vacuum systems or when operated under 5 in., any noncorroding tube or ductwork.

10. Piping systems shall be designed and sized to deliver the required flow rates for the utilization pressures.

11. Mains and branches in medical gas piping systems shall be not less than DN15 (NPS 1/2) (5/8 in. O.D.) size.

12. Mains and branches in medical-surgical vacuum systems shall be not less than DN20 (NPS 3/4) (7/8 in. O.D.) size.

13. Drops to individual station outlets and inlets shall be not less than DN15 (NPS 1/2) (5/8 in. O.D.) size.

14. Runouts to alarm panels and connecting tubing for gauges and alarm devices shall be permitted to be DN8 (NPS 1/4) (3/8 in. O.D.) size.

15. Piping shall be supported from the building structure.

16. Hangers and supports shall comply with MSS SP-58.

17. Supports for copper tube shall be sized for copper tube.

18. In potentially damp locations, hangers or supports that are in contact with the tube shall be plastic-coated or otherwise electrically insulated from the tube by a material that will not absorb moisture.

19. Maximum support spacing shall be 5 ft. for ¼ in. tubing; 6 ft. for 3/8 and ½ in. tubing; 7 ft. for ¾ in. tubing; 8 ft. for 1 in. tubing; 9 ft. for 1 ¼ in. tubing; and 10 ft. for 1 ½ in. tubing.

20. Vertical risers of all sizes shall be supported at every floor but not to exceed 15 ft.

21. Where required, medical gas and vacuum piping shall be seismically restrained against earthquakes in accordance with the applicable building code.
22. Flared and compression-type connections and unions in medical gas systems are prohibited. This includes connections to station outlets, alarm devices, etc.

23. Threaded connections shall be limited to devices such as pressure/vacuum gauges, alarm devices, check valves and source equipment. Threaded joints shall be tapered threads complying with ASME B1.20.1.

24. Turns, off-sets and changes in directions shall be made with fittings; bending of tubing is prohibited.

25. Medical gas piping shall be protected from freezing, corrosion, and physical damage.

26. Piping exposed in corridors and other areas subject to physical damage from carts, stretchers, portable equipment, or vehicles shall be suitably protected.

27. Piping underground within buildings or embedded in concrete floors or concrete walls shall be in a continuous conduit.

28. Pipe risers shall be permitted to be installed in pipe shafts if protected from physical damage, excessive heat, corrosion, or contact with oil.

29. Piping shall not be installed in kitchens, elevator shafts, elevator machine rooms, areas with open flames and electrical service equipment over 600 volts except room locations for medical air compressor supply systems and medical-surgical vacuum pump supply systems and room locations containing secondary electrical distribution circuit panels and breakers having a maximum voltage of 600 volts.

30. Where medical gas piping is installed in the same trench or tunnel as fuel gas lines, fuel oil lines, electric lines, steam lines and similar utilities, the space shall be naturally or mechanically ventilated to limit temperatures in the space to 130 degrees.

31. Medical gas piping shall not be located where subject to contact with oil, including flooding caused by major oil leaks.

32. Hoses and flexible connectors shall be no longer than necessary and shall not penetrate or be concealed in walls, floors, ceilings, or partitions.

33. Hoses and flexible connectors shall have a minimum burst pressure of 1000 psi.

34. Where an existing system is being converted for operation at another pressure or for another gas, the existing system shall comply with the provisions of a new system.

35. Vacuum systems shall never be converted for use as a medical gas system.

36. Piping shall be labeled by stenciling or adhesive markers that identify patient medical gas, support gas, or vacuum system including the name of the gas/vacuum system or chemical symbol, the color code and where positive pressure systems operate at pressures other than standard gauge pressure, the label shall include the operating pressure.

37. Pipe labels shall be located at intervals of not more than 20 ft., at least once in or above every room, on both sides of walls or partitions penetrated by piping and at least once in every story height of riser piping.
IX. UNDERGROUND PIPING OUTSIDE OF BUILDINGS

1. Medical gas piping shall be buried below the local level of frost penetration.  
   NFPA 99, Sec. 5.1.10.11.5.1

2. Underground installations shall be protected from damage during backfilling using conduit, cover or other enclosure.  
   NFPA 99, Sec. 5.1.10.11.5.2

3. When protected by conduit, cover or other enclosure, access to joints shall be provided and the conduit, cover or enclosure shall be self draining and not retain groundwater in prolonged contact with the pipe.  
   NFPA 99, Sec. 5.1.10.11.5.3

4. Buried piping that will be subject to surface loads shall be buried at a depth that will protect the piping or its enclosure from excessive stresses.  
   NFPA 99, Sec. 5.1.10.11.5.4

5. The minimum cover for buried pipe outside of buildings shall be 36 inches; where physical damage is not likely to occur, minimum bury depth may be reduced to 18 inches.  
   NFPA 99, Sec. 5.1.10.11.5.5

6. Trenches shall be excavated so that the pipe or its enclosure has firm, substantial continuous bearing on the trench bottom.  
   NFPA 99, Sec. 5.1.10.11.5.6

7. Backfill shall be clean and compacted so as to protect and uniformly support the pipe or its enclosure.  
   NFPA 99, Sec. 5.1.10.11.5.7

8. A continuous tape or marker shall be placed directly above buried pipe identifying the pipeline by specific name.  
   NFPA 99, Sec. 5.1.10.11.5.8

9. Continuous warning means shall be provided above buried piping approximately ½ of the depth of bury.  
   NFPA 99, Sec. 5.1.10.11.5.9

10. Where underground piping is installed through a wall sleeve, the ends of the sleeve shall be sealed to prevent the entrance of ground water into the building.  
    NFPA 99, Sec. 5.1.10.11.5.10

APPLICABLE CODES AND STANDARDS

NOTE:
Compliance with all items on this list does not necessarily assure compliance with all provisions of the applicable codes and standards. This reminder list should be used only by persons with a comprehensive knowledge of the applicable codes and standards.

OSHPD Policy Intent Notices and Code Application Notices  
http://www.oshpd.ca.gov/FDD/Regulations/CANs/index.html
OSHPD Project Review Status  
http://www.oshpd.ca.gov/FDD/project_status/index.asp
OSHPD Public Use Forms  
http://www.oshpd.ca.gov/FDD/Forms/index.html