14.2.10 Communications and Monitoring.

14.2.10.1 General.

14.2.10.1.1 Electrical monitoring equipment used inside the chamber shall comply with the applicable requirements of 14.2.9.

14.2.10.1.2 Detectors, sensors, transducers, and communications equipment located inside the chamber shall meet the requirements of 14.2.9.3.15 for Class A chambers and 14.2.9.6 for Class B chambers.

14.2.10.1.3 Wiring methods in the chamber shall meet the applicable requirements in 14.2.9.3.

14.2.10.1.4 The following equipment shall be installed outside the chamber or shall meet the requirements of 14.2.9.3.15:

(1) Control equipment
(2) Power amplifiers
(3) Output transformers
(4) Monitors associated with communications and monitoring equipment

14.2.10.2* Intercommunications.

14.2.10.2.1* An intercommunications system shall connect all personnel compartments (locks) and the chamber operator's control console.

14.2.10.2.2* Closed-circuit television monitoring of the chamber interior shall be employed for chamber operators who do not have direct visual contact with the chamber interior from their normal operating location.

14.2.10.2.3 Oxygen mask microphones shall be intrinsically safe at the maximum proposed pressure and 95 ± 5 percent oxygen.

14.2.10.3 Combustible Gas Detection.

Δ **14.2.10.3.1** The chamber atmosphere shall be continuously monitored for combustible gas concentrations whenever any volatile agents are used in the chamber.

14.2.10.3.1.1 The monitor shall be set to provide audible and visual alarms at 10 percent lower explosive limit (LEL) for the particular gas used.

14.2.10.4 Oxygen Monitoring.

14.2.10.4.1 Oxygen levels shall be continuously monitored in any chamber in which nitrogen is added to the chamber or to reduce the volumetric concentration of oxygen in the atmosphere.

14.2.10.4.1.1 Oxygen monitors shall be equipped with audible and visual alarms.

14.2.10.4.1.2 Sample response time, at all treatment levels, shall be no more than 30 seconds.

14.2.10.4.2* Oxygen levels shall be continuously monitored in Class A chambers when breathing mixtures containing in excess of 21 percent oxygen by volume are being breathed by patients or attendants, when any flammable agents are present in the chamber, or when both conditions exist.

14.2.10.4.2.1 Audible and visual alarms shall indicate volumetric oxygen concentrations in excess of 23.5 percent range for Class A chambers.

14.2.10.4.2.2* At least one sample port shall be equipped with a removable extension to allow for spot-checking of any location within the chamber.

14.2.10.5 Carbon Dioxide Monitoring. The chamber atmosphere shall be monitored for carbon dioxide levels during saturation operations whenever ventilation is not used.

14.2.10.6* Chamber Gas Supply Monitoring.

14.2.10.6.1* As a minimum, the air supplied from compressors to all classes of chambers shall meet the requirements for CGA Grade E with the added requirement that condensed hydrocarbons and particulates shall be less than 0.1 mg/m^3.

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Δ **14.2.10.6.2** When air cylinders are used to provide breathing air in chambers, the breathing air shall be medical air USP.

Δ **14.2.10.6.3** When cylinders are used to provide oxygen in chambers, the gas shall be oxygen USP.

14.2.11 Other Equipment and Fixtures.

14.2.11.1 All furniture permanently installed in the hyperbaric chamber shall be grounded.

14.2.11.2* Exhaust from all classes of chambers shall be piped outside of the building.

14.2.11.2.1 Each Class B and Class C chamber shall have an independent exhaust line.

14.2.11.2.2 The point of exhaust shall not create a hazard.

14.2.11.2.3 The point of exhaust shall not allow reentry of gases into the building.

14.2.11.2.4 The point of exhaust shall be protected by the provision of a minimum of 0.3 cm (0.12 in.) mesh screen and situated to prevent the intrusion of rain, snow, or airborne debris.

14.2.11.2.5* The point of exhaust shall be identified as an oxygen exhaust by a sign prohibiting smoking or open flame and the sign shall include a pictograph indicating "no smoking" and "no open flame — flame" in accordance with NFPA 170.

14.3 Administration and Maintenance.

14.3.1 General.

14.3.1.1 Purpose. Section 14.3 contains requirements for administration and maintenance that shall be followed as an adjunct to physical precautions specified in Section 14.2.

14.3.1.2* Recognition of Hazards. The nature and recognition of hyperbaric hazards are outlined in Annex B of this document and shall be reviewed by the safety director.

14.3.1.3 Responsibility.

14.3.1.3.1 Personnel having responsibility for the hyperbaric facility, and those responsible for licensing, accrediting, or approving institutions or other facilities in which hyperbaric installations are employed, shall establish and enforce programs to fulfill the provisions of this chapter.

14.3.1.3.2* Each hyperbaric facility shall designate an on-site hyperbaric safety director to be in charge of all hyperbaric equipment and the operational safety requirements of this chapter.

14.3.1.3.2.1 The safety director shall participate with facility management personnel and the hyperbaric physician(s) in developing procedures for operation and maintenance of the hyperbaric facility.

14.3.1.3.2.2 The safety director shall make recommendations for departmental safety policies and procedures.

14.3.1.3.2.3 The safety director shall have the authority to restrict or remove any potentially hazardous supply or equipment items from the chamber.

14.3.1.3.3* The governing board shall be responsible for the care and safety of patients and personnel.

14.3.1.3.4* By virtue of its responsibility for the professional conduct of members of the medical staff of the health care facility, the organized medical staff shall adopt and enforce regulations with respect to the use of hyperbaric facilities located in health care facilities.

14.3.1.3.4.1 The safety director shall participate in the development of these regulations.

14.3.1.3.5* The safety director shall ensure that electrical, monitoring, life-support, protection, and ventilating arrangements in the hyperbaric chamber are inspected and tested as part of the routine maintenance program of the facility.

14.3.1.4 Rules and Regulations.

14.3.1.4.1* General. The administrative, technical, and professional staffs shall jointly develop policies for management of the hyperbaric facility.

14.3.1.4.1.1 Upon adoption, the management policies shall be available in the facility.

14.3.1.4.2 The medical director of hyperbaric medicine and the safety director shall jointly develop the minimum staff qualifications, experience, and complement based on the following:

(1) Number and type of hyperbaric chambers in use
(2) Maximum treatment capacity
(3) Type of hyperbaric therapy normally provided

14.3.1.4.3 All personnel, including those involved in maintenance and repair of the hyperbaric facility, shall be trained on the purpose, application, operation, and limitations of emergency equipment.

14.3.1.4.4 When an inspection, test, or maintenance procedure of the fire suppression system results in the system being placed out of service, a protocol shall be followed that notifies appropriate personnel and agencies of the planned or emergency impairment.

14.3.1.4.5 A sign indicating the fire suppression system is out of service shall be conspicuously placed on the operating console until the fire suppression system is restored to service.

14.3.1.4.6* During chamber operations with an occupant(s) in a chamber, the operator shall be physically present and shall maintain visual or audible contact with the control panel or the chamber occupant(s).

14.3.1.5 Emergency Procedures.

14.3.1.5.1 Emergency procedures specific to the hyperbaric facility shall be established.

14.3.1.5.2* All personnel shall be trained in emergency procedures.

14.3.1.5.3 Personnel shall be trained to control the chamber and decompress occupants when all powered equipment has been rendered inoperative.

14.3.1.5.4* Emergency procedures and fire training drills shall be conducted at least annually and documented by the safety director.

14.3.1.5.4.1 The time required to evacuate all persons from a hyperbaric area with a full complement of chamber occupants all at treatment pressure shall be measured annually.

14.3.1.5.4.2 The occupants for the timed evacuation drill shall be permitted to be simulated.

14.3.1.6 General.

14.3.1.6.1 Potential Ignition Sources.

14.3.1.6.1.1* The following shall be prohibited from inside the chamber and the immediate vicinity outside the chamber:

(1) Smoking
(2) Open flames
(3) Hot objects

14.3.1.6.1.2 The following shall be prohibited from inside the chamber:

(1) Personal warming devices (e.g., therapeutic chemical heating pads, hand warmers, pocket warmers)
(2) Personal electrically powered devices (e.g., laptops, electronic tablets, cell phones, pagers)
(3) Sparking toys
(4) Personal entertainment devices

Δ **14.3.1.6.1.3*** Prior to each hyperbaric treatment, a pretreatment safety check to identify and remove prohibited items shall be performed and documented by a qualified person.

14.3.1.6.2 Flammable Gases and Liquids.

14.3.1.6.2.1 Flammable agents, including devices such as laboratory burners employing bottled or natural gas and cigarette lighters, shall be prohibited inside the chamber and from the proximity of the compressor intake.

14.3.1.6.2.2 For Class A chambers, flammable agents used for patient care, such as alcohol swabs, parenteral alcohol-based pharmaceuticals, and topical creams, shall be permitted in the chamber if the following conditions are met:

(1) Such use is approved by the safety director or other authority having jurisdiction.
(2)* The quantities of such agents are limited so that they are incapable of releasing sufficient flammable vapor into the chamber atmosphere to exceed the LEL for the material.
(3) A safety factor is included to account for the localized concentrations, stratification, and the absence of ventilation.
(4) The oxygen monitoring requirement of 14.2.10.4.2 is observed.

14.3.1.6.2.3 Flammable liquids, gases, or vapors shall not be permitted inside any Class B chamber.

14.3.1.6.3* Personnel.

14.3.1.6.3.1 Antistatic procedures, as directed by the safety director, shall be employed whenever atmospheres containing more than 23.5 percent oxygen by volume are used.

14.3.1.6.3.2 In Class A and Class B chambers with atmospheres containing more than 23.5 percent oxygen by volume, electrical grounding of the patient shall be ensured by the provision of a high-impedance conductive pathway in contact with the patient's skin.

14.3.1.6.3.3 Shoes having ferrous nails that make contact with the floor shall not be permitted to be worn in Class A chambers.

14.3.1.6.4* Textiles.

14.3.1.6.4.1 Except where permitted in 14.3.1.6.4.3, silk, wool, or synthetic textile materials, or any combination thereof, shall be prohibited in Class A or Class B chambers.

14.3.1.6.4.2* Garments permitted inside of chambers shall be as follows:

(1) Garments fabricated of 100 percent cotton or a blend of cotton and polyester fabric shall be permitted in Class A chambers.
(2) Garments fabricated of 100 percent cotton, or a blend of cotton and polyester fabric containing no more than 50 percent polyester, shall be permitted in Class B chambers.

Δ **14.3.1.6.4.3*** The physician in charge, with the concurrence of the safety director, shall be permitted to approve the use of the following prohibited items in the chamber:

(1) Suture material
(2) Alloplastic devices
(3) Bacterial barriers
(4) Surgical dressings
(5) Biological interfaces
(6) Synthetic textiles

14.3.1.6.4.4 Physician and safety director approval to use prohibited items shall be stated in writing for all prohibited materials employed. *(See A.14.3.1.3.2.)*

14.3.1.6.4.5 Upholstered Furniture.

Δ **(A)** Upholstered furniture (fixed or portable) shall be resistant to smoldering (or cigarette) ignition in accordance with one of the following:

(1) The components of the upholstered furniture shall meet the requirements for Class 1 when tested in accordance with NFPA 260.
(2) Mocked-up composites of the upholstered furniture shall have a char length not exceeding 38 mm (1½ in.) when tested in accordance with NFPA 261.

(B) Upholstered furniture shall have limited rates of heat release when tested in accordance with ASTM E1537, *Standard Test Method for Fire Testing of Upholstered Furniture*, or with California Technical Bulletin 133, *Flammability Test Procedure for Seating Furniture for Use in Public Occupancies*, as follows:

(1) The peak rate of heat release for the single upholstered furniture item shall not exceed 80 kW.
(2) The total heat released by the single upholstered furniture item during the first 10 minutes of the test shall not exceed 25 MJ.

14.3.1.6.4.6 Mattresses.

Δ **(A)** Mattress components shall have a char length not exceeding 2 in. (51 mm) when tested in accordance with 16 CFR 1632, "Standard for the Flammability of Mattresses and Mattress Pads (FF 4-72)," or NFPA 260.

(B) Mattresses shall have limited rates of heat release when tested in accordance with ASTM E1590, *Standard Test Method for Fire Testing of Mattresses*, or California Technical Bulletin 129, *Flammability Test Procedure for Mattresses for Use in Public Buildings*, as follows:

(1) The peak rate of heat release for the mattress shall not exceed 100 kW.
(2) The total heat released by the mattress during the first 10 minutes of the test shall not exceed 25 MJ.

14.3.1.6.4.7 Fill materials contained within upholstered furniture and mattresses shall comply with the open flame test in Section A-1 of the 2000 edition of California Technical Bulletin 117, *Requirements, Test Procedure and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture*.

14.3.1.6.4.8 For materials with fire-retardant coatings, the material shall be maintained in accordance with the manufacturer's instructions to retain the fire-retardant properties.

14.3.1.6.4.9 Exposed foamed plastic materials shall be prohibited.

14.3.1.6.5 The use of flammable hair sprays, hair oils, and skin oils shall be prohibited for all chamber occupants/patients as well as personnel.

14.3.1.6.5.1 Whenever possible, patients shall be stripped of all clothing, particularly if it is contaminated by dirt, grease, or solvents, and then reclothed. *(See A.14.3.1.6.4.)*

14.3.1.6.5.2 All cosmetics, lotions, and oils shall be removed from the patient's body and hair.

14.3.1.6.6 All other fabrics used in the chamber, such as sheets, pillow cases, and blankets, shall conform to 14.3.1.6.4.1 and 14.3.1.6.4.2.

14.3.1.6.7 Drapes used within the chamber shall meet the flame propagation performance criteria contained in Test 1 or Test 2, as appropriate, of NFPA 701.

14.3.1.6.8 Clothing worn by patients in Class A or Class B chambers and personnel in Class A chambers shall, prior to each treatment, conform to the following:

(1) They shall be issued by the hyperbaric facility or specifically approved by the safety director for hyperbaric use.
(2) They shall be uncontaminated.
(3) They shall be devoid of prohibited articles prior to chamber pressurization.

14.3.1.6.9* Paper brought into the chamber shall be stored in a closed metal container.

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14.3.2 Equipment.

14.3.2.1 All equipment used in the hyperbaric chamber shall comply with Section 14.2, including the following:

(1) All electrical and mechanical equipment necessary for the operation and maintenance of the hyperbaric facility
(2) Any medical devices and instruments used in the facility

Δ **14.3.2.1.1** Use of unapproved equipment shall be prohibited.

14.3.2.1.2 The following devices shall not be operated in the hyperbaric chamber unless approved for such use by the safety director and medical director of hyperbaric medicine:

(1) Portable x-ray devices
(2) Electrocautery equipment
(3) High-energy devices

14.3.2.1.3 Photographic equipment employing the following shall not remain in the chamber when the chamber is pressurized:

(1) Photoflash
(2) Flood lamps

Δ **14.3.2.1.4** The use of Class 1 or Class 2 lasers as defined by ANSI Z136.3, *American National Standard for Safe Use of Lasers in Health Care*, shall be permitted.

14.3.2.1.5 Equipment known to be, or suspected of being, defective shall not be introduced into any hyperbaric chamber or used in conjunction with the operation of such chamber until repaired, tested, and accepted by qualified personnel and approved by the safety director. *(See 14.3.1.3.2.)*

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14.3.2.2* The following shall be all-metal to the extent possible:

(1) Oxygen containers
(2) Valves
(3) Fittings
(4) Interconnecting equipment

14.3.2.3 The following shall be compatible with oxygen under service conditions:

(1) Valve seats
(2) Gaskets
(3) Hose
(4) Lubricants

14.3.2.4 Equipment used inside the chamber requiring lubrication shall be lubricated with oxygen-compatible material.

14.3.2.4.1 Factory-sealed antifriction bearings shall be permitted to be used with standard hydrocarbon lubricants in Class A chambers that do not employ atmospheres of increased oxygen concentration.

14.3.2.5* Equipment made of the following shall be prohibited from the chamber interior:

(1) Cerium
(2) Magnesium
(3) Magnesium alloys

14.3.2.6* In the event that radiation equipment is introduced into a hyperbaric chamber, hydrocarbon detectors shall be installed.

14.3.2.6.1 In the event that flammable gases are detected in excess of 1000 ppm, radiation equipment shall not be operated until the chamber atmosphere is cleared.

14.3.3 Handling of Gases.

14.3.3.1 The institution's administrative personnel shall develop policies for safe handling of gases in the hyperbaric facility. *(See 14.3.1.6.2.)*

14.3.3.2 Oxygen and other gases shall not be introduced into the chamber in the liquid state.

14.3.3.3 Flammable gases shall not be used or stored in the chamber or in the hyperbaric facility.

14.3.3.4* Pressurized containers of gas shall be permitted to be introduced into the hyperbaric chamber, provided that the container and its contents are approved for such use by the safety director.

14.3.4 Inspection, Testing, and Maintenance.

14.3.4.1 General.

14.3.4.1.1 The hyperbaric safety director shall ensure that all valves, regulators, meters, and similar equipment used in the hyperbaric chamber are compensated for use under hyperbaric conditions and tested as part of the routine maintenance program of the facility.

14.3.4.1.1.1 Pressure relief valves shall be tested and calibrated as part of the routine maintenance program of the facility.

14.3.4.1.2 The hyperbaric safety director shall ensure that all gas outlets are labeled or stenciled in accordance with CGA C-7, *Guide to Classification and Labeling of Compressed Gases*.

14.3.4.1.3 The requirements set forth in Section 5.1 and NFPA 55 concerning the storage, location, and special precautions required for medical gases shall be followed.

14.3.4.1.4 Storage areas for hazardous materials shall not be located in the room housing the hyperbaric chamber. *(See 14.2.1.)*

14.3.4.1.4.1 Flammable gases, except as provided in 14.3.1.6.2.2(1), shall not be used or stored in the hyperbaric room.

14.3.4.1.5 All replacement parts and components shall conform to original design specification.

14.3.4.1.6* Air from compressors shall be sampled at least every 6 months and after major repair or modification of the compressor(s).

14.3.4.2 Maintenance Logs.

14.3.4.2.1 Installation, repairs, and modifications of equipment related to a chamber shall be evaluated by engineering personnel, tested under pressure, and approved by the safety director.

14.3.4.2.1.1 Logs of all tests shall be maintained.

14.3.4.2.2 Operating equipment logs shall be maintained by engineering personnel.

14.3.4.2.2.1 Operating equipment logs shall be signed before chamber operation by the person in charge. *(See A.14.3.1.3.2.)*

14.3.4.2.3 Operating equipment logs shall not be taken inside the chamber.

Δ **14.3.4.3 Fire Protection Equipment for Class A Hyperbaric Chambers.**

14.3.4.3.1 Electrical switches, valves, and electrical monitoring equipment associated with fire protection shall be visually inspected before each chamber pressurization.

14.3.4.3.1.1 Where provided, water level indicators shall be visually inspected before each chamber pressurization.

14.3.4.3.1.2 Where provided, air pressure gauges shall be visually inspected before each chamber pressurization.

14.3.4.3.2 Fire detection equipment, if installed, shall be tested each week.

14.3.4.3.2.1 Testing shall include activation of trouble circuits and signals.

14.3.4.3.3 Full testing, including discharge of extinguishing media, shall be conducted annually.

14.3.4.3.4 Inspection, testing, and maintenance of the water storage tanks for Class A chambers shall be in accordance with applicable sections of Chapter 9 of NFPA 25.

Δ **14.3.4.3.5*** Fire extinguishing systems shall be functionally tested at least semiannually as follows:

(1) For deluge systems, in accordance with the requirements of 14.2.6.2.5 and 14.2.6.2.7
(2) For handline systems, in accordance with the requirements of 14.2.6.3.7.1

14.3.4.3.5.1 Following the test, all valves shall be placed in their baseline position.

14.3.4.3.5.2 If a bypass system is used, it shall not remain in the test mode after completion of the test.

14.3.4.3.5.3 During initial construction, or whenever changes are made to the installed deluge system that will affect the spray pattern, testing of spray coverage to demonstrate conformance to the requirements of 14.2.6.2.6 shall be performed at surface pressure and at maximum operating pressure.

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14.3.4.3.5.4 A detailed record of the test results shall be maintained and a copy sent to the hyperbaric facility safety director.

14.3.4.3.5.5 Inspection, testing, and maintenance of hyperbaric fire suppression systems shall be performed by a qualified person.

14.3.4.4 Electrical Safeguards.

14.3.4.4.1 All electrical circuits shall be tested in accordance with the routine maintenance program of the facility.

14.3.4.4.1.1 Electrical circuit tests shall include the following:

(1) Ground-fault check to verify that no conductors are grounded to the chamber
(2) Test of normal functioning *(see 14.2.9.2.3.2)*

14.3.4.4.1.2 In the event of fire, all nonessential electrical equipment within the chamber shall be de-energized before extinguishing the fire.

(A) Smoldering, burning electrical equipment shall be de-energized before extinguishing a localized fire involving only the equipment. *(See 14.2.6.)*

14.3.4.5 Furniture and Grounding.

14.3.4.5.1 Conductive devices on furniture and equipment shall be inspected to ensure that they are free of wax, lint, or other extraneous material that could insulate them and defeat the conductive properties.

14.3.4.5.2* Casters or furniture leg tips shall not be capable of impact sparking.

14.3.4.5.3 Casters shall not be lubricated with oils or other flammable materials.

14.3.4.5.4 Lubricants shall be oxygen compatible.

14.3.4.5.5 Wheelchairs and gurneys with bearings lubricated and sealed by the manufacturer shall be permitted in Class A chambers where conditions prescribed in 14.2.10.4 are met.

14.3.4.6* Electrostatic Safeguards.

14.3.4.6.1 Conductive accessories shall meet conductivity and antistatic requirements.

14.3.4.6.2* Patient ground shall be verified in Class B chambers prior to each chamber operation.

14.3.4.6.3* Patient ground shall be verified in Class A chambers prior to chamber operation whenever atmospheres containing more than 23.5 percent oxygen by volume are used.

14.3.4.6.4 Chamber ground shall be verified to be in accordance with 14.2.9.4.1.3 for Class A and Class B chambers as part of the preventive maintenance program of the facility.

14.3.4.6.5* Materials containing rubber shall be inspected as part of the routine maintenance program of the facility, especially at points of kinking.

14.3.4.7* Housekeeping. A housekeeping program shall be implemented, whether or not the facility is in regular use.

14.3.4.7.1 The persons assigned to the task of housekeeping shall be trained in the following:

(1) Potential damage to the equipment from cleaning procedures
(2) Potential personal injury
(3) Specific cleaning procedures
(4) Equipment not to be cleaned

Chapter 15 Dental Gas and Vacuum Systems

15.1 Applicability. This chapter shall apply to dental health care facilities that qualify to install dental gas and vacuum piping systems.

15.1.1 Category 1 dental piped gas and piped vacuum system requirements shall be applied in facilities where general anesthesia and deep sedation is performed, as defined in 3.3.68.1 and 3.3.68.2.

15.1.2 Category 2 dental piped gas and piped vacuum system requirements shall be applied in facilities where only moderate and minimal sedation is performed, as defined in 3.3.68.3 and 3.3.68.4.

15.1.3 Category 3 dental piped gas and piped vacuum system requirements shall be applied in facilities where minimal or no sedation is performed, as defined in 3.3.68.4.

15.1.4 A single facility shall be permitted to include dental gas and vacuum systems for more than one category of dental piped gas and vacuum systems.

15.1.5 An existing system that is not in strict compliance with the provisions of this code shall be permitted to continue in use unless the authority having jurisdiction has determined that such use constitutes a distinct hazard to life.

15.1.6 The requirements for Category 1 dental gas and vacuum systems for the operation, management, and maintenance of gas and vacuum piping systems shall apply to both new and existing facilities within the scope of this chapter and in accordance with 5.1.1.5.

15.1.7 The following sections of this chapter shall apply to the operation, management, and maintenance of Category 2 dental gas and vacuum systems in both new and existing facilities:

(1) 15.1.5
(2) 15.2
(3) 15.4.2.4.3
(4) 15.4.2.4.5
(5) 15.4.2.4.13
(6) 15.4.2.5.14
(7) 15.4.2.6.4
(8) 15.4.9

15.1.8 The following sections of this chapter shall apply to the operation, management, and maintenance of Category 3 dental gas and vacuum systems in both new and existing facilities:

(1) 15.1.5
(2) 15.2
(3) 15.5.8

N **15.1.9** Where the term *Responsible Facility Authority* is used, that entity shall follow the requirements of 5.1.14.1.

15.2 Nature of Hazards of Gas and Vacuum Systems. Potential fire and explosion hazards associated with positive-pressure dental gas systems and vacuum systems shall be considered in the design, installation, testing, operation, and maintenance of these systems.

15.3 Category 1 Dental Gas and Vacuum Systems.

15.3.1 General. Facilities that perform deep sedation and general anesthesia associated with dental treatment shall meet the requirements for Category 1 dental gas and vacuum systems.

15.3.2 Category 1 Medical Gas Systems (Dental).

15.3.2.1 Medical Gas and Vacuum Sources.

15.3.2.1.1 Central Supply System Identification and Labeling. Category 1 systems shall comply with 5.1.3.1.

15.3.2.1.2 Central Supply Operations. Category 1 systems shall comply with 5.1.3.2.

15.3.2.1.3 Central Supply System Locations. Category 1 systems shall comply with 5.1.3.3.

15.3.2.1.4 Central Supply Systems. Category 1 systems shall comply with 5.1.3.5.

15.3.2.1.5 Medical Air Supply Systems. Category 1 systems shall comply with 5.1.3.6, except as follows:

(1) Medical air compressors, dryers, aftercoolers, filters, and regulators shall be permitted to be simplex.
(2) The facility staff shall develop their emergency plan to deal with the loss of medical air.

15.3.2.1.6 Oxygen supply systems using concentrators shall be permitted to consist of two sources, one of which shall be a cylinder header with sufficient cylinder connections for an average day's supply.

15.3.2.1.7 Medical–Surgical Vacuum Systems. Category 1 systems shall comply with 5.1.3.7, except as follows:

(1) Medical–surgical vacuum systems shall be permitted to be simplex.
(2) The facility staff shall develop their emergency plan to deal with the loss of medical–surgical vacuum.

15.3.2.1.8 WAGD Systems. Category 1 systems shall comply with 5.1.3.8, except as follows:

(1) Medical WAGD pumps shall be permitted to be simplex.
(2) The facility staff shall develop their emergency plan to deal with the loss of WAGD.

15.3.2.2 Valves. Category 1 systems shall comply with 5.1.4.

15.3.2.3 Station Outlets and Inlets. Category 1 systems shall comply with 5.1.5.

15.3.2.4 Manufactured Assemblies. Category 1 systems shall comply with 5.1.6.

15.3.2.5 Surface-Mounted Medical Gas Rails. Category 1 systems shall comply with 5.1.7.

15.3.2.6 Pressure and Vacuum Indicators. Category 1 systems shall comply with 5.1.8.

15.3.2.7 Warning Systems. Warning systems associated with Category 1 systems shall provide the master, area, and local alarm functions of a Category 1 system as required in 5.1.9, except as follows:

(1) Warning systems shall be permitted to be a single alarm panel.
(2) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.
(3) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel.

15.3.2.8 Medical Gas Distribution. Category 1 systems shall comply with 5.1.10.

15.3.2.9 Labeling and Identification. Category 1 systems shall comply with 5.1.11.

15.3.2.10 Performance Criteria and Testing (Medical Gas, Medical–Surgical Vacuum, and WAGD). Category 1 systems shall comply with 5.1.12.

15.3.2.11 Support Gases. Category 1 systems shall comply with 5.1.13 except as follows:

(1) Nitrogen source equipment shall be permitted to be installed in enclosures for Category 3 medical gases or in a mechanical room.
(2) Nitrogen source equipment shall include the following:

(a) One or more cylinders of nitrogen NF, sufficient for at least one average day's supply
(b) A manifold, if primary and secondary cylinders are provided
(c) A line pressure regulating valve
(d) A check valve downstream from the pressure regulating valve
(e) A pressure relief valve set at 50 percent above the normal line pressure and located downstream from the check valve
(f) A pressure relief valve discharge piped to the outdoors at a point that will not create a probable hazard and that is turned down to prevent the entry of rain or snow

15.3.2.12 Medical Gas and Vacuum Operation and Management. Category 1 systems shall comply with 5.1.14.

15.3.3 Category 1 Dental Air and Vacuum Piping Systems.

15.3.3.1 General.

15.3.3.1.1 Dental air and vacuum piping systems shall include dental support gases and dental vacuum systems.

15.3.3.1.2 Dental vacuum systems shall include dental vacuum and nitrous oxide scavenging.

15.3.3.2 Equipment Locations for Dental Air and Vacuum Systems.

15.3.3.2.1 General. Any of the following systems shall be permitted to be located together in the same room:

(1) Medical air compressor supply sources
(2) Dental air compressor sources and reserve headers
(3) Dental-surgical vacuum sources
(4) Dental vacuum sources
(5) WAGD sources
(6) Any other compressor, vacuum pump, or electrically powered machinery

15.3.3.2.2 Cylinders and Containers. Cylinders and containers for gases shall be handled in accordance with Chapter 11.

15.3.3.2.3 Ventilation. The following source locations for motor-driven equipment shall be adequately ventilated to prevent accumulation of heat:

(1) Medical air sources
(2) Instrument air sources
(3) Dental compressed air sources
(4) Dental-surgical vacuum sources
(5) Dental vacuum sources
(6) WAGD sources

15.3.3.3 Dental Gas and Vacuum Source Equipment.

15.3.3.3.1 General.

15.3.3.3.1.1 The capacity of source equipment shall be based on the design requirements for the facility, including the number of gas outlets, vacuum inlets, and other connections, and their individual capacities.

15.3.3.3.1.2 The system design requirements shall be included in the data used for testing and verifying the operation of the gas and vacuum piping systems.

15.3.3.4* Dental Air.

15.3.3.4.1 General.

15.3.3.4.1.1 Dental air shall be used as a support gas for driving dental tools and shall be permitted to be used to supply air-driven equipment. Dental compressed air shall not be used for respiration.

15.3.3.4.1.2 Dental air outlets shall not be interchangeable with any other gas outlets, including oxygen, nitrous oxide, medical air, instrument air, and nitrogen.

15.3.3.4.2 Dental Air Compressor Units.

15.3.3.4.2.1 Dental air compressor units shall include dental air compressors, vibration isolation, air receivers, coalescent air filters, adsorption dryers, exhaust silencer/filters, moisture indicators, and service access manifolds, electrical disconnects, motor wiring, and controls.

15.3.3.4.2.2 Air compressors shall be scroll dental, reciprocating dental, or the oil-free dental types.

15.3.3.5* Dental Vacuum.

15.3.3.5.1 General.

15.3.3.5.1.1 Dental vacuum shall be used for oral evacuation and nitrous oxide scavenging.

15.3.3.5.1.2 Dental vacuum inlets shall not be interchangeable with any other vacuum inlets, including dental-surgical vacuum.

15.3.3.5.2 Dental Vacuum Units.

15.3.3.5.2.1 Dental vacuum units shall include dental vacuum pumps, vibration isolation, separation tanks, vacuum inlet, vacuum exhaust, condensate drain, motor wiring, and controls.

15.3.3.5.2.2 Dental vacuum pumps shall be dental dry vacuum or dental liquid (wet) ring pumps. Pumps shall be oil-free or oil-lubricated, and suitable for nitrous oxide scavenging.

15.3.3.6 Nitrous Oxide Scavenging.

15.3.3.6.1 General.

15.3.3.6.1.1 The use of scavenging shall be limited to portions of dental facilities where moderate or minimal sedation is administered. WAGD shall be provided where the dental treatment involves general anesthesia or deep sedation.

15.3.3.6.1.2 Active nitrous oxide scavenging shall include the use of a nasal mask on the patient. The nasal mask shall be connected to a scavenging inlet in the dental vacuum system through a flow-limiting adapter.

15.3.3.6.1.3 Nitrous oxide scavenging inlets shall not be interchangeable with any other vacuum inlets, including medical-surgical vacuum, dental vacuum, and WAGD.

15.3.3.6.2 Connection to Dental Vacuum. Scavenging connections to the dental vacuum system shall be a direct high-volume evacuation (HVE) connection to a high-volume vacuum port with a capacity of 45 L/min (1.6 cfm).

15.3.3.7 Piping for Dental Air and Vacuum Systems.

15.3.3.7.1 General.

15.3.3.7.1.1 Piping for dental compressed air systems shall comply with 15.3.3.7.2.

15.3.3.7.1.2 Piping for dental vacuum systems and scavenging systems shall comply with 15.3.3.7.3.

15.3.3.7.2 Piping for Dental Air Systems.

15.3.3.7.2.1 General. Pipe, fittings, and joints in piping for dental compressed air systems shall be in accordance with 15.3.3.7.2.2 through 15.3.3.7.2.5.

Δ **15.3.3.7.2.2 Pipe.** Pipe under 15.3.3.7.2 shall comply with the following:

(1) ASTM B88, *Standard Specification for Seamless Copper Water Tube*, Type L or K
(2) ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*, Type L or K
(3) ASTM B280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*, ACR tube (O.D. size)

15.3.3.7.2.3 Copper tube shall be hard temper or annealed (soft temper).

15.3.3.7.2.4 Fittings. Fittings for piping under 15.3.3.7.2 shall be permitted to be any of the following acceptable joining methods:

(1) Brazed or soldered fittings conforming to ASME B16.22, *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*
(2) Brazed fittings conforming to ANSI/ASME B16.50, *Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings*
(3) Brazed fittings conforming to ASME B16.22 with socket depths equal to or greater than braze-joint pressure fittings in compliance with ANSI/ASME B16.50
(4) Flared fittings conforming to ASME B16.26, *Cast Copper Alloy Fittings for Flared Copper Tubes*
(5) Compression fittings (¾ in. maximum size)

15.3.3.7.2.5 Joints. Joints for piping under 15.3.3.7.2 shall comply with the following:

(1) Joints shall be brazed, soldered, threaded, flared, or the compression type.
(2) Where joints are brazed, they shall comply with the requirements of 15.4.6.
(3) Soldered joints shall be made in accordance with ASTM B828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*, using a "lead-free" solder filler metal containing not more than 0.2 percent lead by volume that complies with ASTM B32, *Standard Specification for Solder Metal*.

15.3.3.7.3 Piping for Dental Vacuum Systems and Scavenging Systems.

15.3.3.7.3.1 General. Piping for dental vacuum systems and scavenging systems shall be copper, PVC plastic, or CPVC plastic.

15.3.3.7.3.2 Copper Piping. Copper piping under 15.3.3.7.3 shall be in accordance with 15.3.3.7.3.2(A) through 15.3.3.7.3.2(D).

(A) Copper Tube. Copper tubing shall comply with the following:

(1) ASTM B88, *Standard Specification for Seamless Copper Water Tube*, Type L or K
(2) ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*, Type L or K
(3) ASTM B280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*, ACR tube (O.D. size)

(B) Copper tube shall be hard temper or annealed (soft temper).

(C) Copper Fittings. Copper fittings shall comply with the following:

(1) Brazed or soldered fittings conforming to ASME B16.22, *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*
(2) Brazed fittings conforming to ANSI/ASME B16.50, *Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings*
(3) Brazed fittings conforming to ASME B16.22 with socket depths equal to or greater than braze-joint pressure fittings conforming to ANSI/ASME B16.50
(4) Flared fittings conforming to ASME B16.26, *Cast Copper Alloy Fittings for Flared Copper Tubes*
(5) Compression fittings (¾ in. maximum size)

(D) Joints for Copper Piping. Joints in copper tubing shall be in accordance with the following:

(1) Joints shall be brazed, soldered, threaded, flared, or the compression type.
(2) Where joints are brazed, they shall comply with the requirements of 15.4.6.
(3) Soldered joints shall be made in accordance with ASTM B828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*, using a "lead-free" solder filler metal containing not more than 0.2 percent lead by volume that complies with ASTM B32, *Standard Specification for Solder Metal*.

15.3.3.7.3.3 PVC Plastic Piping. PVC plastic piping under 15.3.3.7.3 shall be in accordance with the following:

(1) PVC plastic pipe shall be Schedule 40 or Schedule 80, conforming to ASTM D1785, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120*.
(2) PVC plastic fittings shall be Schedule 40 or Schedule 80 to match the pipe, conforming to ASTM D2466, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40*, or ASTM D2467, *Standard Specification Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80*.
(3) Joints in PVC plastic piping shall be solvent-cemented in accordance with ASTM D2672, *Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement*.

15.3.3.7.3.4 CPVC Plastic Piping. CPVC plastic piping under 15.3.3.7.3 shall be in accordance with the following:

(1) CPVC IPS plastic pipe shall be Schedule 40 or Schedule 80, conforming to ASTM F441/F441M, *Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80*.
(2) CPVC IPS plastic fittings shall be Schedule 40 or Schedule 80 to match the pipe, conforming to ASTM F438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*, or ASTM

F439, *Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.*

(3) CPVC CTS plastic pipe and fittings ½ in. through 2 in. size shall be SDR 11, conforming to ASTM D2846/D2846M, *Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.*

(4) Solvent cement for joints in CPVC plastic piping shall comply with ASTM F493, *Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride)(CPVC) Plastic Pipe and Fittings.*

15.4 Category 2 Dental Gas and Vacuum Systems.

15.4.1 General.

15.4.1.1 Category 2 dental gas and vacuum system shall be limited to facilities that, at most, provide moderate and minimal sedation.

15.4.1.2 The medical gases shall be limited to oxygen and nitrous oxide.

15.4.1.3 The dental support gases shall be provided from a dental air source system.

15.4.1.4 The vacuum systems shall be dental vacuum and nitrous oxide scavenging.

15.4.1.5 All connections within Category 2 medical gas (oxygen and nitrous oxide) shall be gas-specific to prevent cross-connections with other piping systems, including vacuum, water, and dental air.

15.4.1.6 Station outlets and piped outlets for Category 2 medical gas and dental air having nonstandard operating pressures shall comply with the following additional requirements:

(1) Be gas-specific.
(2) Be pressure-specific where a single gas is piped at more than one operating pressure.
(3) Be a D.I.S.S connection if operated at a gauge pressure in excess of 550 kPa (80 psi).
(4) Be designed to prevent the removal of the adapter until the pressure has been relieved, if operated at a gauge pressure between 1380 kPa and 2070 kPa (200 psi and 300 psi).

15.4.1.7 Requirements for Category 2 dental gas and vacuum systems relating to the operation, management, and maintenance of oxygen and nitrous oxide piping systems shall apply both new and existing facilities as specified in 15.1.7.

15.4.2 Medical Gas Systems (Oxygen and Nitrous Oxide).

15.4.2.1 Installer Qualifications (Oxygen and Nitrous Oxide).

15.4.2.1.1 Installers of medical gas systems shall be certified in accordance with ASSE 6010, *Professional Qualification Standard for Medical Gas Systems Installers*, regardless of the capacity of the source equipment.

15.4.2.1.2 Installers of medical gas systems shall not use their certification to oversee installation by noncertified personnel.

15.4.2.1.3 Brazing of medical gas piping systems shall be performed by individuals who are qualified in accordance with 15.4.6.1.

15.4.2.1.4 Prior to any installation work involving brazing, the installer of the medical gas piping systems shall provide documentation required by 15.4.6.1 for the qualifications of the brazing procedures and individual brazers.

15.4.2.2 Central Supply System Identification and Labeling (Oxygen and Nitrous Oxide).

15.4.2.2.1 Cylinders, containers, and tanks shall be designed, fabricated, tested, and marked (stamped) in accordance with regulations of DOT, Transport Canada (TC) *Transportation of Dangerous Goods Regulations*, or the ASME *Boiler and Pressure Vessel Code*, "Rules for the Construction of Unfired Pressure Vessels," Section VIII. [**55:**7.1.5.1]

15.4.2.2.2 Cylinder contents shall be identified by attached labels or stencils naming the contents in accordance with the mandatory requirements of CGA C-7, *Guide to Classification and Labeling of Compressed Gases.*

15.4.2.2.3 Liquid containers shall have additional product identification visible from all directions with a minimum of 51 mm (2 in.) high letters such as a 360-degree wraparound tape for medical liquid containers.

15.4.2.2.4 Cryogenic liquid containers shall be provided with gas-specific outlet connections in accordance with the mandatory requirements of CGA V-5, *Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)*, or CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections.*

15.4.2.2.5 Cylinder and cryogenic liquid container outlet connections shall be affixed in such a manner as to be integral to the valve(s), unremovable with ordinary tools, or so designed as to render the attachment point unusable when removed.

15.4.2.2.6 The contents of cylinders and cryogenic liquid containers shall be verified prior to use.

15.4.2.2.7 Labels shall not be defaced, altered, or removed, and connecting fittings shall not be modified.

15.4.2.2.8 Locations containing positive-pressure gases other than oxygen and medical air shall have their door(s) labeled as follows:

Positive-Pressure Gases
NO Smoking or Open Flame
Room May Have Insufficient Oxygen
Open Door and Allow Room to Ventilate Before Entering

15.4.2.2.9 Locations containing central supply systems or cylinders containing only oxygen or medical air shall have their door(s) labeled as follows:

Medical Gases
NO Smoking or Open Flame

15.4.2.3 Central Supply System Operations (Oxygen and Nitrous Oxide).

15.4.2.3.1 The use of adapters or conversion fittings to adapt one gas-specific fitting to another shall be prohibited.

15.4.2.3.2 Cylinders and containers shall be handled in strict accordance with 11.6.2.

15.4.2.3.3 Only gas cylinders, reusable shipping containers, and their accessories shall be permitted to be stored in rooms containing central supply systems or gas cylinders.

15.4.2.3.4 No flammable materials, cylinders containing flammable gases, or containers containing flammable liquids shall be stored in rooms with gas cylinders.

15.4.2.3.5 If cylinders are wrapped when received, the wrappers shall be removed prior to storage.

15.4.2.3.6 Cylinders without correct markings or whose markings and gas-specific fittings do not match shall not be used.

15.4.2.3.7 Cryogenic liquid storage units intended to supply gas to the facility shall not be used to transfill other liquid storage vessels.

15.4.2.3.8 Care shall be exercised when handling cylinders that have been exposed to freezing temperatures or containers that contain cryogenic liquids to prevent injury to the skin.

15.4.2.3.9 Cylinders containing compressed gases and containers for volatile liquids shall be kept away from radiators, steam piping, and like sources of heat.

15.4.2.3.10 Where cylinder valve protection caps are supplied, they shall be secured tightly in place unless the cylinder is connected for use.

15.4.2.3.11 Containers shall not be stored in a tightly closed space.

15.4.2.3.12 Cylinders in use and in storage shall be prevented from reaching temperatures in excess of 52°C (125°F).

15.4.2.3.13 Central supply systems for nitrous oxide and carbon dioxide using cylinders or portable containers shall be prevented from reaching temperatures lower than the recommendations of the central supply system's manufacturer but shall never be lower than –7°C (20°F) or greater than 52°C (125°F).

15.4.2.4 Locations of Medical Gas Source Equipment (Oxygen and Nitrous Oxide).

15.4.2.4.1 Gas storage locations in facilities with Category 2 medical gas systems with a total of all gases in cylinders or containers, except nitrogen, connected and in storage at one time that does not exceed 85 m^3 (3000 ft^3) at standard temperature and pressure (STP), or 142 m^3 (5000 ft^3) (STP) if oxygen is stored in a DOT specification 4 L (cryogenic liquid) container shall comply with 15.4.2.4.3 through 15.4.2.4.13.

15.4.2.4.2* Gas storage locations in facilities with Category 2 medical gas systems with a total of all gases in cylinders or containers exceeding quantities listed in 15.4.2.4.1 shall comply with 5.1.3.3.

15.4.2.4.3 Enclosures shall serve no purpose other than to contain the medical gas source equipment (oxygen and nitrous oxide), except that nitrogen source equipment and compressed air cylinders shall be permitted in the enclosure.

15.4.2.4.4 Storage of full or empty gas cylinders, or both, shall be permitted in the same enclosure.

15.4.2.4.5 Air compressors, vacuum pumps, and other equipment shall not be located in enclosures for medical gas cylinders (oxygen and nitrous oxide source equipment).

15.4.2.4.6* If enclosures are outdoors or remote from the treatment facilities that they serve, they shall be kept locked.

15.4.2.4.7 Cylinders in use and in storage shall be prevented from reaching temperatures in excess of 52°C (125°F). Nitrous oxide cylinders shall be prevented from reaching temperatures lower than –7°C (20°F).

15.4.2.4.8 Only gas cylinders, reusable shipping containers, and their accessories shall be permitted to be stored in rooms containing central supply systems or gas cylinders.

15.4.2.4.9 No flammable materials, cylinders containing flammable gases, or containers containing flammable liquids shall be stored in rooms with gas cylinders.

15.4.2.4.10 Indoor enclosures shall not communicate directly with medical gas (oxygen and nitrous oxide) use points or storage locations for oxidizers.

15.4.2.4.11 Outdoor enclosures that are adjacent to a building wall shall be located such that the distance to any window or door of the adjacent building is greater than 3.05 m (10 ft).

15.4.2.4.12 Enclosures for medical gas (oxygen and nitrous oxide) source equipment shall be provided with doors or gates.

15.4.2.4.13 Cylinders in service or in storage shall be individually secured and located to prevent falling or being knocked over.

15.4.2.5 Medical Gas Source Equipment (Oxygen and Nitrous Oxide).

15.4.2.5.1 Mechanical means shall be provided to ensure that the medical gas source equipment is connected to the correct medical gas distribution piping system.

15.4.2.5.2 Cylinder valve outlets for oxygen and nitrous oxide shall comply with CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections.*

15.4.2.5.3 Threaded connections to manifolds shall comply with CGA V-5, *Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications).*

15.4.2.5.4 A check valve shall be provided downstream of each pressure regulator.

15.4.2.5.5 A pressure relief valve set at 50 percent above the normal line pressure shall be located downstream of the check valve in 15.4.2.5.4.

15.4.2.5.6 Pressure relief valves shall be brass, bronze, or stainless steel and designed for oxygen service.

15.4.2.5.7 Hose and flexible connectors shall have a gauge pressure rating not less than 6895 kPa (1000 psi).

15.4.2.5.8 Materials used in central supply systems shall meet the following requirements:

(1) In those portions of systems intended to handle oxygen at gauge pressures equal to or greater than 2413 kPa (350 psi), interconnecting hose shall contain no polymeric materials.
(2) In those portions of systems intended to handle oxygen or nitrous oxide material, construction shall be compatible with oxygen under the temperatures and pressures to which the components can be exposed.
(3) If potentially exposed to cryogenic temperatures, materials shall be designed for low temperature service.
(4) If intended for outdoor installation, materials shall be installed per the manufacturer's requirements.

15.4.2.5.9 Nonmetallic hoses and flexible connectors shall not exceed 1.52 m (5 ft) in length and shall not be concealed or penetrate walls, floors, ceilings, or partitions.

N **15.4.2.5.9.1** Source equipment shall not be connected to the piping system through flexible connectors.

15.4.2.5.10 Medical gas source equipment that serves one or two treatment facilities shall include two banks of one or more cylinders of oxygen and (if used) two banks of one or more cylinders of nitrous oxygen, each bank containing at least one average day's supply.

15.4.2.5.11 The two banks of each medical gas source shall be manifolded so that either bank can supply its distribution piping system.

15.4.2.5.12 Where the source equipment is remote from a single treatment facility and an in use bank is unable to supply the system, the manifold shall automatically switch to the secondary bank.

15.4.2.5.13 Where the source equipment serves multiple treatment facilities and an in use bank is unable to supply the system, the manifold shall automatically switch to the secondary bank.

15.4.2.5.14 Where the source equipment is not remote and is accessible from a single treatment facility served and an in use bank is unable to supply the system, the manifold shall be manually or automatically switched to the secondary bank.

15.4.2.6 Emergency Shutoff Valves (Oxygen and Nitrous Oxide).

Δ **15.4.2.6.1*** All Category 2 medical gas systems shall have an emergency shutoff valve accessible from all use-point locations in an emergency.

15.4.2.6.2 Where a central medical gas supply system supplies two treatment facilities, each facility shall be provided with an emergency shutoff valve located in that treatment facility so as to be accessible from all use-point locations in an emergency.

15.4.2.6.3 Emergency shutoff valves shall be labeled to indicate the gas controlled by the shutoff valve and shall shut off only the gas to the treatment facility that they serve.

15.4.2.6.4 A remotely activated shutoff valve at a gas supply manifold shall not be used for emergency shutoff.

15.4.2.6.4.1 For clinical purposes, such a remote valve actuator shall not fail-close in the event of loss of electric power.

15.4.2.6.4.2 Where remote actuators are the type that fail-open, it shall be mandatory that cylinder shutoff valves be closed whenever the system is not in use.

15.4.2.7 Station Outlets and Risers (Oxygen and Nitrous Oxide).

15.4.2.7.1 Each gas outlet shall be gas-specific.

15.4.2.7.2 Gas outlets shall consist of a primary and a secondary valve or assembly.

15.4.2.7.3 Each gas outlet shall be legibly identified.

15.4.2.7.4 Threaded outlets shall be noninterchangeable connections complying with the mandatory requirements of CGA V-5, *Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications).*

15.4.2.7.5 Factory-installed copper inlet tubes on station outlets extending no further than 205 mm (8 in.) from the body of the terminal shall be not less than DN8 (NPS ¼) (⅜ in. O.D.) size, with 8 mm (0.3 in.) minimum inside diameter.

15.4.2.8 Manufactured Assemblies (Oxygen and Nitrous Oxide). Category 2 systems shall comply with 5.1.6.

15.4.2.9 Pressure and Vacuum Indicators (Oxygen and Nitrous Oxide). Category 2 systems shall comply with 5.1.8.

15.4.2.10 Warning Systems (Oxygen and Nitrous Oxide). Category 2 warning systems shall comply with 5.2.9, except as follows:

(1) Warning systems shall be permitted to be a single alarm panel.
(2) The alarm panel shall be located in an area of continuous surveillance while the facility is in operation.
(3) Pressure and vacuum switches/sensors shall be mounted at the source equipment with a pressure indicator at the master alarm panel.
(4) Warning systems for medical gas systems shall provide the following alarms:
    (a) Oxygen main line pressure low
    (b) Oxygen main line pressure high
    (c) Oxygen changeover to secondary bank or about to changeover (if automatic)
    (d) Nitrous oxide main line pressure low
    (e) Nitrous oxide main line pressure high
    (f) Nitrous oxide changeover to secondary bank or about to changeover (if automatic)
(5) Audible and noncancelable alarm visual signals shall indicate if the pressure in the main line increases or decreases 20 percent from the normal operating pressure.
(6) Visual indications shall remain until the situation that caused the alarm is resolved.
(7) Pressure switches/sensors shall be installed downstream of any emergency shutoff valves and any other shutoff valves in the system and shall cause an alarm for the medical gas if the pressure decreases or increases 20 percent from the normal operating pressure.
(8) A cancelable audible indication of each alarm condition that produces a sound at the alarm panel shall reinitiate the audible signal if another alarm condition occurs while the audible signal is silenced.

15.4.2.11 Labeling and Identification. Category 2 systems shall comply with 5.1.11.

15.4.3 Category 2 Dental Air and Vacuum Piping Systems.

15.4.3.1 General.

15.4.3.1.1 Dental air and vacuum piping systems shall include dental support gases and dental vacuum systems.

15.4.3.1.2 Dental vacuum systems shall include dental vacuum and nitrous oxide scavenging.

15.4.3.2 Equipment Locations for Dental Air and Vacuum Systems.

15.4.3.2.1 General. Any of the following systems shall be permitted to be located together in the same room:

(1) Dental air compressor sources and reserve headers
(2) Dental-surgical vacuum sources
(3) Dental vacuum sources