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.

14.3.1.6.10 Containers used for paper storage shall be emptied after each chamber operation.

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

14.3.2.1.1 Use of unapproved equipment shall be prohibited. *(See 14.3.1.6.4.3.)*

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

(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 the 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.)*

Δ **14.3.2.1.6** Equipment that does not meet the temperature requirements of 500.8(A), 500.8(B), and 500.8(C) of *NFPA 70* shall not be permitted in the chamber.

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.

Δ **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*.

Δ **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.)*

Δ **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.

14.3.4.3 Fire Protection Equipment Inside for Class A Hyperbaric Chambers.

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

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

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

Δ **14.3.4.3.2** Fire detection equipment shall be tested each week.

14.3.4.3.2.1 Testing shall include activation of trouble circuits and signals.

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

N **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.

14.3.4.3.5* The deluge and handline systems shall be functionally tested at least semiannually per 14.2.6.2.7 for deluge systems and 14.2.6.3.7 for handline systems.

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.

(A) The requirements of 14.2.6.2.6 shall be satisfied under both surface pressure and maximum operating pressure.

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.

N **14.3.4.6.1** Conductive accessories shall meet conductivity and antistatic requirements.

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

N **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.

N **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

N Chapter 15 Dental Gas and Vacuum Systems

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

N 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 3.3.66.1 and 3.3.66.2.

N 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 3.3.66.3 and 3.3.66.4.

N 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 3.3.66.4.

N 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.

N 15.1.5 An existing system that is not in strict compliance with the requirements of this code shall be permitted to continue in use as long as the authority having jurisdiction has determined that such use does not constitute a distinct hazard to life.

N 15.1.6 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

N 15.1.7 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 15.2 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.

N 15.3 Category 1 Dental Gas and Vacuum Systems.

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

N 15.3.1.1 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.

N 15.3.2 Category 1 Medical Gas Systems (Dental).

N 15.3.2.1 Medical Gas and Vacuum Sources.

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

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

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

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

N 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.

N 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.

N 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.

N 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.

N 15.3.2.2 Valves. Category 1 systems shall comply with 5.1.4.

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

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

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

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

N 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.

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

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

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

N **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, each providing 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 outdoors at a point that will not create a probable hazard and that is turned down to prevent the entry of rain or snow

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

N **15.3.3 Category 1 Dental Air and Vacuum Piping Systems.**

N **15.3.3.1 General.**

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

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

N **15.3.3.2 Equipment Locations for Dental Air and Vacuum Systems.**

N **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

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

N **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

N **15.3.3.3 Dental Gas and Vacuum Source Equipment.**

N **15.3.3.3.1 General.**

N **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.

N **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.

N **15.3.3.4* Dental Air.**

N **15.3.3.4.1 General.**

N **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.

N **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.

N **15.3.3.4.2 Dental Air Compressor Units.**

N **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.

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

N **15.3.3.5* Dental Vacuum.**

N **15.3.3.5.1 General.**

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

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

N **15.3.3.5.2 Dental Vacuum Units.**

N **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.

N **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.

N **15.3.3.6 Nitrous Oxide Scavenging.**

N **15.3.3.6.1 General.**

N **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.

N **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.

N **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.

N **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).

N **15.3.3.7 Piping for Dental Air and Vacuum Systems.**

N **15.3.3.7.1 General.**

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

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

N **15.3.3.7.2 Piping for Dental Air Systems.**

N **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.

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

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

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

N **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)

N **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.*

N **15.3.3.7.3 Piping for Dental Vacuum Systems and Scavenging Systems.**

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

N **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).

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

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

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

N **(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)

N **(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.*

N **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.*

N **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 Chlorinated) (CPVC) Plastic Pipe Fittings, Schedule 40*, or ASTM F439, *Standard Specification for Chlorinated Poly (Vinyl Chlorinated) (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, *Solvent Cements for CPVC Pipe and Fittings*.

N 15.4 Category 2 Dental Gas and Vacuum Systems.

N 15.4.1 General.

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

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

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

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

N 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 drive gas.

N 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).

N 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 15.1.6.

N 15.4.2 Medical Gas Systems (Oxygen and Nitrous Oxide).

N 15.4.2.1 Installer Qualifications (Oxygen and Nitrous Oxide).

N 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.

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

N 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.

N 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.

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

N 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]

N 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*.

N 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.

N 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*.

N 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.

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

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

N 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

N 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

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

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

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

N 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.

N 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.

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

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

N 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.

N 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.

N 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.

N 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.

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

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

N 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).

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

N 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.

N 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.

N 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.

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

N 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).

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

N 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).

N 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.

N 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.

N 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.

N 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).

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

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

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

N 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.

N 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.*

N 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).*

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

N 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.

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

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

N **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.

N **15.4.2.5.9** Flexible connectors of other than all-metal construction that connect manifolds to the gas distribution piping shall not exceed 1.52 m (5 ft) in length and shall not penetrate walls, floors, ceilings, or partitions.

N **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.

N **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.

N **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.

N **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.

N **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.

N **15.4.2.6 Emergency Shutoff Valves (Oxygen and Nitrous Oxide).**

N **15.4.2.6.1*** Where a central medical gas supply is remote from a single treatment facility, the main supply line shall be provided with an emergency shutoff valve located in the single treatment facility so as to be accessible from all use-point locations in an emergency.

N **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.

N **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.

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

N **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.

N **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.

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

N **15.4.2.7.1** Each gas outlet shall be gas-specific.

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

N **15.4.2.7.3** Each gas outlet shall be legibly identified.

N **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)*.

N **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.

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

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

N **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.

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

N 15.4.3 Category 2 Dental Air and Vacuum Piping Systems.

N 15.4.3.1 General.

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

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

N 15.4.3.2 Equipment Locations for Dental Air and Vacuum Systems.

N 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
(4) Any other compressor, vacuum pump, or electrically powered machinery

N 15.4.3.2.2 Cylinders and Containers. Cylinders and containers for gases shall be handled in accordance with Chapter 11.

N 15.4.3.2.3 Ventilation for Motor-Driven Equipment. The following source locations 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

N 15.4.3.3 Dental Gas and Vacuum Source Equipment.

N 15.4.3.3.1 General.

N 15.4.3.3.1.1 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.

N 15.4.3.3.1.2 The system design requirements shall be included in the data used for testing and verifying the operation of the gas and vacuum piping systems.

N 15.4.3.3.2 Dental Air.

N 15.4.3.3.2.1 General.

N (A) 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.

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

N 15.4.3.3.2.2 Dental Air Compressor Units.

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

N (B) Air compressors shall be scroll dental, reciprocating dental, or the oil-free dental types.

N 15.4.3.3.3 Dental Vacuum.

N 15.4.3.3.3.1 General.

N (A) Dental vacuum shall be used for oral evacuation and nitrous oxide scavenging.

N (B) Dental vacuum inlets shall not be interchangeable with any other vacuum inlets, including dental-surgical vacuum.

N 15.4.3.3.3.2 Dental Vacuum Units.

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

N (B) 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.

N 15.4.3.3.4 Nitrous Oxide Scavenging.

N 15.4.3.3.4.1 General.

N (A) 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.

N (B) 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.

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

N 15.4.3.3.4.2 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).

N 15.4.3.4 Category 2 Warning Systems (Oxygen and Nitrous Oxide).

N 15.4.3.4.1 General.

N 15.4.3.4.1.1 The warning systems in Category 2 dental gas and vacuum systems shall comply with applicable requirements of 5.2.9 and 15.4.3.4.2 through 15.4.3.4.4.

N 15.4.3.4.1.2 The master, area, and local alarm functions shall be permitted to be provided by a single alarm panel, as indicated in 5.2.9.

N 15.4.3.4.2 Master Alarm Panels.

N 15.4.3.4.2.1 A master alarm panel shall be located in the facility at a point of continuous surveillance when the facility is in operation.

N 15.4.3.4.2.2 The master alarm panel shall indicate the following:

(1) Oxygen supply pressure ±20 percent from normal
(2) Nitrous oxide supply pressure ±20 percent from normal
(3) Changeover of oxygen supply source
(4) Changeover of nitrous oxide supply source

N 15.4.3.4.3 Area Alarm Panels.

N 15.4.3.4.3.1 An area alarm panel shall be centrally located where two or more treatment areas are supplied from the same zoned dental gas and vacuum piping.

N 15.4.3.4.3.2 Area alarm panels shall indicate the following:

(1) Oxygen supply pressure ±20 percent from normal
(2) Nitrous oxide supply pressure ±20 percent from normal

N 15.4.3.4.4 Local Alarms.

N 15.4.3.4.4.1 Local alarms shall be located in source equipment control panels or separate control panels in the equipment rooms for source equipment.

N 15.4.4 Piping for Category 2 Medical Gas, Dental Air, and Vacuum Systems.

N 15.4.4.1 General.

N 15.4.4.1.1 Piping for the following systems shall comply with 15.4.4.2:

(1) Oxygen
(2) Nitrous oxide

N 15.4.4.1.2 Piping for dental air systems shall comply with 15.4.4.3.

N 15.4.4.1.3 Piping for dental vacuum systems and scavenging systems shall comply with 15.4.4.4.

N 15.4.4.2 Piping for Oxygen and Nitrous Oxide Systems.

N 15.4.4.2.1 Cleaning for Oxygen Service. For oxygen and nitrous oxide, the pipe, fittings, valves, gas/vacuum outlets/inlets, and other piping components shall be cleaned for oxygen by the manufacturer prior to installation in accordance with CGA G-4.1, *Cleaning Equipment for Oxygen Service*. Fittings shall be permitted to be cleaned by a supplier or agency other than the manufacturer.

N 15.4.4.2.2 Pipe. Pipe shall be hard-drawn seamless copper tube conforming to ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems, Type L or K.*

N 15.4.4.2.3 Fittings.

N 15.4.4.2.3.1 Fittings shall be brazed, memory metal, or axially swaged.

N 15.4.4.2.3.2 Brazed fittings shall be the wrought copper capillary type complying with the following:

(1) ASME B16.22, *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*
(2) ANSI/ASME B16.50, *Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings*
(3) ASME B16.22 with socket depths equal to or greater than brazed joint pressure fittings in accordance with ANSI/ASME B16.50

N 15.4.4.2.3.3 Cast copper alloy fittings shall not be used with field-brazed joints.

N 15.4.4.2.3.4 Memory metal fittings shall be rated for not less than 538°C (1000°F) and 2070 kPa (300 psi) and shall be installed by qualified technicians in accordance with the manufacturer's instructions.

N 15.4.4.2.3.5 Axially swaged couplings shall be elastic strain preloaded with metal-to-metal seats, rated for not less than 538°C (1000°F) and 2070 kPa (300 psi), and shall provide permanent, nonseparable joints. Fittings shall be installed by qualified technicians in accordance with the manufacturer's instructions.

N 15.4.4.2.4 Joints.

N 15.4.4.2.4.1 Brazed. Brazing of copper joints shall be in accordance with 15.4.6.

N 15.4.4.2.4.2 Threaded. Threaded joints shall be limited to connections to pressure indicators, alarm devices, and source equipment and shall comply with the following:

(1) Threads shall be tapered complying with ASME B1.20.1, *Pipe Threads, General Purpose, Inch.*
(2) Threads shall be made up with polytetrafluoroethylene (PTFE) tape or other thread sealant recommended for oxygen service, with the sealant applied to the male threads only.

N 15.4.4.2.4.3 Prohibited Joints. The following joints shall be prohibited under 15.4.4.2.4:

(1) Flared and compression connections, including connections to station outlets, alarm devices, and other components
(2) Push-lock connections
(3) Straight-threaded connections, including unions
(4) Pipe crimping tools used to permanently stop the flow of medical gas and vacuum piping

N 15.4.4.3 Piping for Dental Air Systems.

N 15.4.4.3.1 General. Pipe, fittings, and joints in piping for dental compressed air systems shall be in accordance with 15.4.4.3.2 through 15.4.4.3.4.

N 15.4.4.3.2 Pipe. Pipe under 15.4.4.3 shall comply with the following:

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

N 15.4.4.3.2.1 Copper tube shall be hard temper or annealed (soft temper).

N 15.4.4.3.3 Fittings. Fittings for piping under 15.4.4.3 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)

N 15.4.4.3.4 Joints. Joints for piping under 15.4.4.3 shall comply with 15.4.4.3.4.1 through 15.4.4.3.4.3.

N 15.4.4.3.4.1 Joints shall be brazed, soldered, threaded, flared, or the compression type.

N 15.4.4.3.4.2 Where joints are brazed, they shall comply with the requirements of 15.4.6.

N 15.4.4.3.4.3 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*.

N 15.4.4.4 Piping for Dental Vacuum Systems and Scavenging Systems.

N 15.4.4.4.1 General. Piping for dental vacuum systems and scavenging systems shall be copper, PVC plastic, or CPVC plastic.

N 15.4.4.4.2 Copper Piping. Copper piping under 15.4.4.4 shall be in accordance with 15.4.4.4.2.1 through 15.4.4.4.2.3.

N 15.4.4.4.2.1 Copper Tube. Copper tubing shall be hard temper or annealed (soft temper) and shall comply with the following:

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

N 15.4.4.4.2.2 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)

N 15.4.4.4.2.3 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*.

N 15.4.4.4.3 PVC Plastic Piping. PVC plastic piping under 15.4.4.4 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 for 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*.

N 15.4.4.4.4 CPVC Plastic Piping. CPVC plastic piping under 15.4.4.4 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 Chlorinated) (CPVC) Plastic Pipe Fittings, Schedule 40*, or ASTM F439, *Standard Specification for Chlorinated Poly (Vinyl Chlorinated) (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, Solvent Cements for CPVC Pipe and Fittings.

N 15.4.4.5 Piping for Nitrogen. Nitrogen piping in dental facilities shall comply with 15.4.4.2, including cleaning for oxygen service.

N 15.4.5 Installation of Medical Gas, Dental Air, and Vacuum Piping.

N 15.4.5.1 General.

N 15.4.5.1.1 Gas and vacuum piping systems shall be as listed in Section 15.4.

N 15.4.5.1.2 Piping materials shall be as listed in 15.4.4.

N 15.4.5.2 Pipe Sizing. Piping systems shall be designed and sized to deliver the required flow rates at the utilization pressures.

N 15.4.5.3 Minimum Pipe Sizes. The minimum size of the following piping shall be as follows:

(1) Category 2 oxygen piping shall be not less than DN10 (NPS ⅜ in.) (½ in. O.D.) size.
(2) Category 2 nitrous oxide piping shall be not less than DN8 (NPS ¼ in.) (⅜ in. O.D.) size.

N 15.4.5.4 Location of Piping. Piping shall not be located where subject to contact with oil.

N 15.4.5.5 Protection of Piping.

N 15.4.5.5.1 Piping shall be protected against freezing, corrosion, and physical damage.

N 15.4.5.5.2 Piping exposed in corridors and other locations where subject to physical damage from the movement of equipment shall be protected.