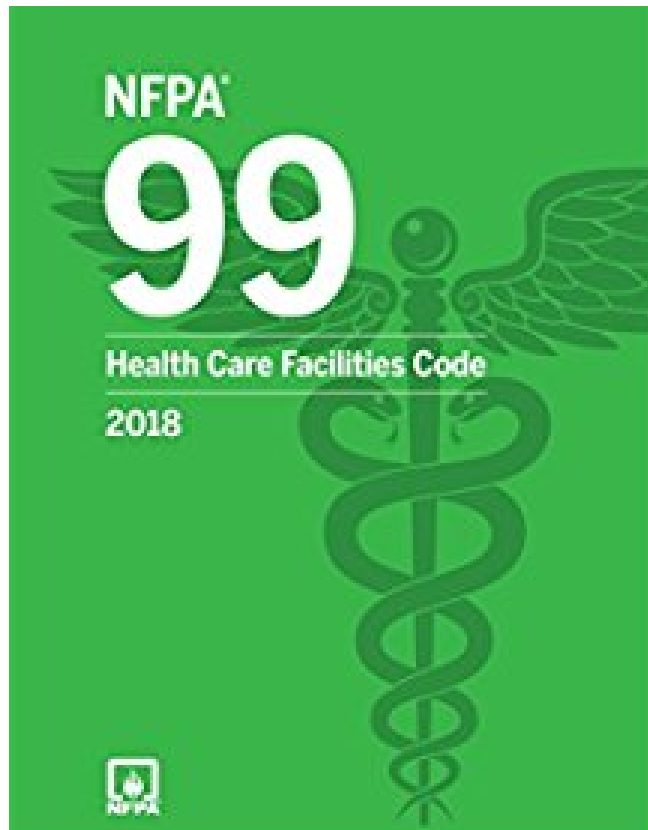


NFPA 99, 2018 APPLICABLE MED GAS CHANGES



NFPA 99, 2018 Edition

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Medical Gas Equipment Sales and Service
Environmental Exposure Evaluations
1-800-872-8992

Central Supply Systems - New

Central Supply System. Central supply systems comprise the equipment necessary to produce, condition, control, and monitor the gases or vacuum. They include all equipment from the atmospheric intake on air compressors, exhaust on vacuum pumps, and cylinders or containers for pressurized gases through to the source valve (see 5.1.4.2). Examples of central supply systems include air compressor sources, vacuum pump sources, cylinder and container headers and manifolds, liquid bulk gas systems proportioning systems and combinations thereof.



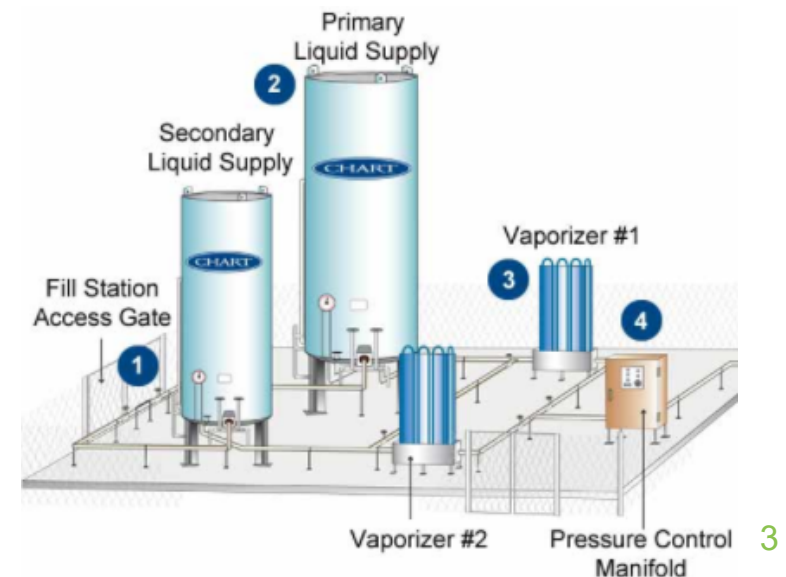
Outdoor Gas Supply Gates

- **Non-Cryogenic** Gas Supplies must have 2 entry/exits if outdoor & enclosure is $>200 \text{ ft}^2$

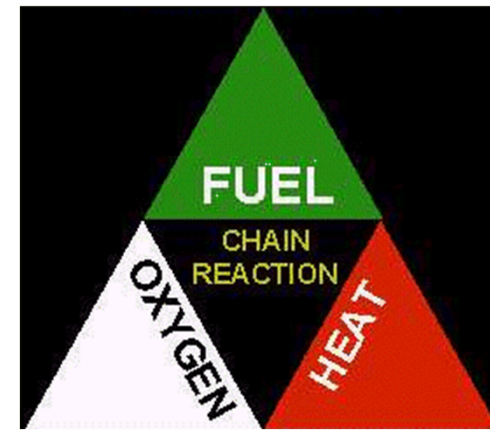
Formerly – all outdoor supplies required two. Now smaller cylinder manifold enclosures ($<14 \times 14'$) only require one entry/exit

5.1.3.3.2* Design and Construction. Locations for central supply systems and the storage of positive-pressure gases shall meet the following requirements:

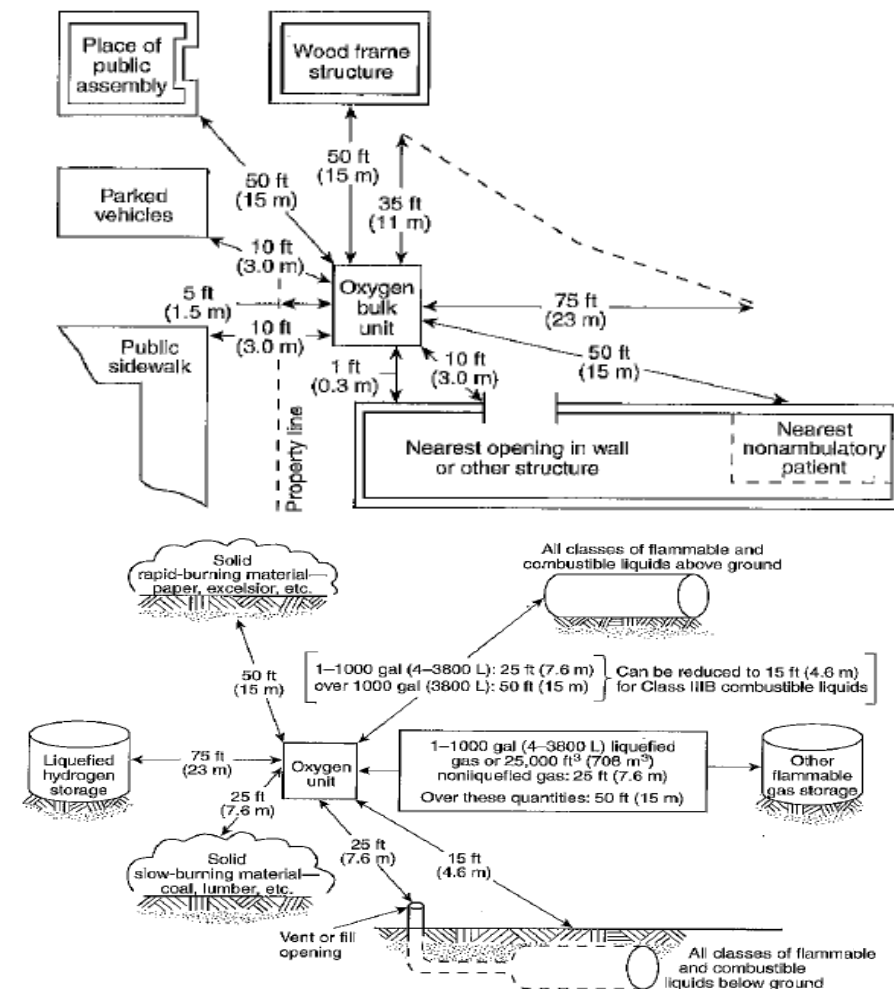
- (4) If outdoors and greater than 18.6 m^2 (200 ft^2), they shall be provided with a minimum of two entry/exits.
- (5) If outdoors, bulk cryogenic liquid systems shall be provided with a minimum of two entry/exits.



Distance Between Bulk Oxygen Systems & Exposures (NFPA 55)



- 1' - all structures (Type I & II)
- * 50' - wood framed Type III, IV, or V building types
- 50' - Public assembly or nearest non-ambulatory patient
- * 5' - Property lines & overhead electrical wiring
- 10' - Building openings
- * 10' - Public sidewalks & parked vehicles
- * 15' - Hazardous piping materials & below ground flammable liquid tanks
- * 25' - 0-1000 gal flammable liquids/liquefied gas, below ground flammable liquid fill or vent, 0-25,000 scf flammable gases, or slow burning solids
- * 50' - >1000 gal flammable liquids/liquefied gas, >25,000 scf flammable gases, or rapidly burning solids
- 3' - combustible surfaces (asphalt & expansion joint filler) where liquid oxygen may fall
- 8' - Sewer or drain openings to delivery connects, reliefs, mobile supply equipment, & liquid withdrawal connects
- Walls may not form a "court"(3-4 sides)



* *These distances do not apply if a 2 hour fire rated wall interrupts the line of sight between un-insulated portions of the bulk & the exposure*

Manifold Room Heating Elements

- The maximum temperature of the heating element is 266°F for indoor gas supplies rooms.

One radiant “Electric Wall Heating Panel” surface temperature reaches 194-266°F (e.g. Deelat®)

5.1.3.3.2 (9)

Gas Supplies - Indoor - Fuel fired equipment is still not allowed inside the manifold room

Will need a definition of "fuel fired equipment" – one would assume no fuel in the manifold room, but that natural gas, oil heaters would be fine in another location 5.1.3.3.2 (10)

Gas Supplies - Indoor - Max temperature of the heating element is 266°F if inside the manifold room. This is a big departure from the former requirement for "indirect heat"

Radiant Electric Wall Heating Panel - 20" x 35" x 0.8" - 450W,110V



General Description

Radiant Electric Wall Heating Panel - 20" x 35" x 0.8" - 450W,110V

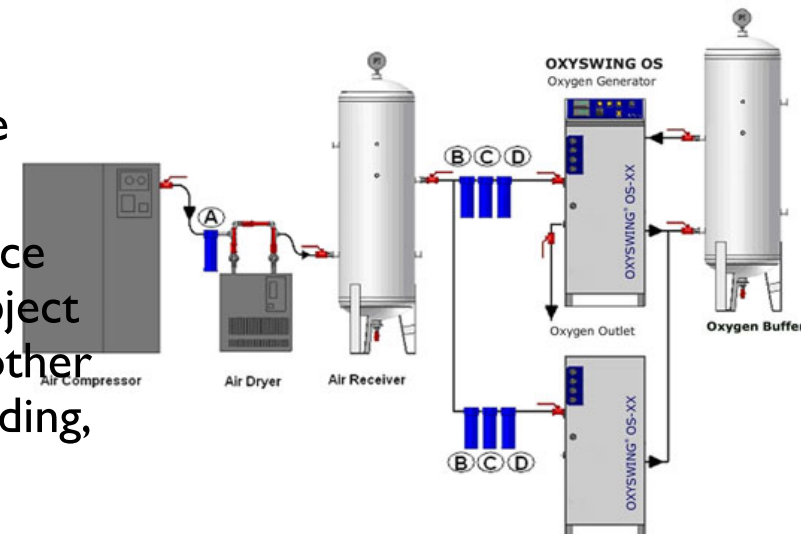
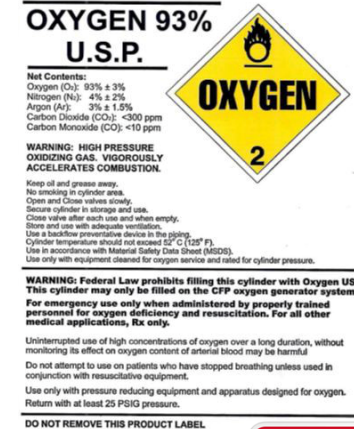
The radiant electric wall heating panel has dimensions of 20" x 35" x 0.8" and is 450W. The unit is 110V with a carbon crystal heating element and silver aluminum frame. The surface temperature reaches 194-266°F.

Function

The radiant electric wall heating panel has a heating element that transfers heat to a room by infrared radiation and is fortified with an aluminum sheet to more effectively reflect heat into the room. The unit is installed on a wall or ceiling using anchored screws and plugs into a wall outlet using a standard 6.2' cable.

O2-93 Central Supply Systems

- Produce oxygen meeting requirements of Oxygen 93 USP or Oxygen USP
- $\leq 1 \text{ mg/m}^3$ of particulate sized $1 \text{ }\mu\text{m}$ or larger @ atmospheric pressure
- Air side of concentrator - manufacturer determines suitable materials
- Oxygen side of concentrator - must comply with 5.1.3.5.4 (*No polymeric materials for O₂ >350psig, cleaned for O₂, materials designed to handle pressure & temperature as may be experienced, designed for cryogenic temperatures if exposed, & outdoor installations per manufacturer*)
- Air Receivers & Oxygen accumulators must be certified pressure vessels with relief valves
- Supply air quality to ensure the unit can produce oxygen complying with 5.1.3.5.1 I.1 and not subject to anticipated contamination from vehicle or other exhaust, gas leakage, discharge from vents, flooding, etc.

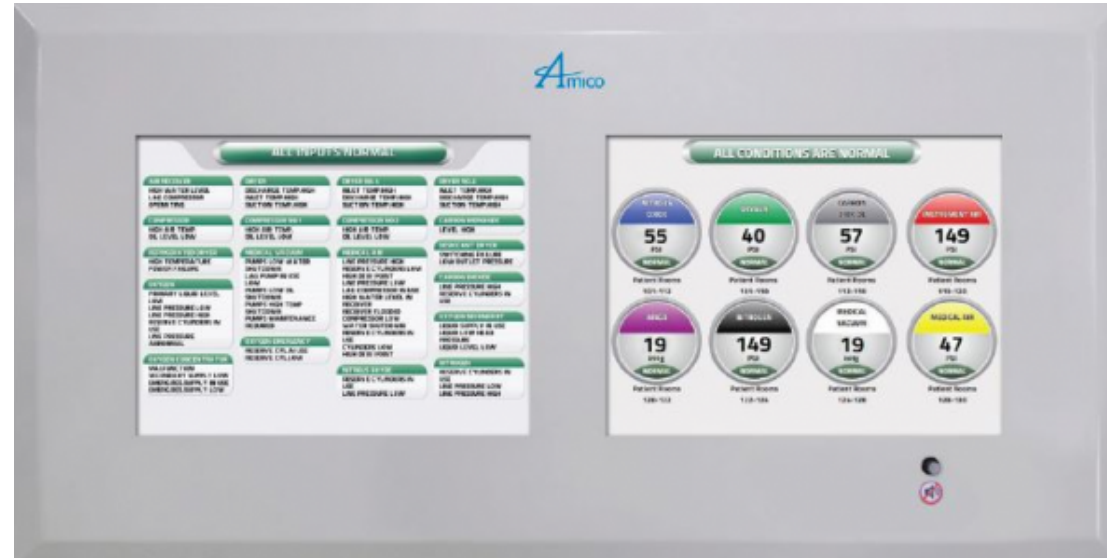


USP 93 Oxygen Supplies

- These supply sources have been included in ISO & Canadian Standards for several years
- NFPA is the preferred code in Alaska, Hawaii many countries where these systems are an important option
- Oxygen side may be with indoor or outdoor bulks, cylinders, or manifolds.
- Air side (compressors, dryer, & air receivers) may be in the same room as medical air/instrument air compressors, vacuum/WAGD pumps, other pumps, compressors, or electrically powered machinery
- Concentrator units with air & oxygen sides in an integral unit may be in the same room as medical air/instrument air compressors, vacuum/WAGD pumps, other pumps, compressors, or electrically powered machinery
- The air side of the oxygen concentrator may not be in the same enclosure or room as cylinder/container manifolds, bulks, or IBER headers

Central Oxygen Concentrator Supply Master Alarm Signals

- Master Alarm Signals for central oxygen concentrator supplies require the following master alarm signals:
 1. Oxygen concentrator unit <91%
 2. Oxygen system <91%
 3. Oxygen concentrator unit isolation valve closed
 4. Oxygen header in use
 5. Oxygen header low pressure (< 1 average day's supply)
 6. Oxygen source failure - change of supply in use
 7. Low regulator supply pressure
 8. High Line Pressure
 9. Low Line Pressure



USP O2 93 Verification Testing

- The verifier's medical gas concentration test for Oxygen 93
USP allowable concentrations shall be $\geq 90\%$ oxygen $\leq 96\%$





Instrument Air Sources



- The minimum output pressure of instrument air compressors is no longer 200 psig, but now may be only the pressure needed for the intended line pressure (no longer 200 psig)
- *Note: Instrument Air is a support gas with a standard pressure of 160-185 psig. System labeling must include the normal pressure if different than the designated standard pressure. i.e. outlets, all shut offs, piping*
- Using ~60 psig "Non-Medical Air" instead of Instrument Air does not require costly zone valves, area alarms, master alarms, special instrument air labels, and a very expensive source supply. In my opinion Instrument Air is "permitted," but not "required" to be used for boom brakes, and a much less expensive Non-Medical Air system is also permitted to be used for boom brakes.

5.1.13.1.1 Support gases are any gases that are used primarily for powering equipment used in patient care procedures (typical support gases are nitrogen and instrument air). Support gas applications require delivery at pressures, cleanliness, or purities specific to their intended function(s) (e.g., to operate medical–surgical tools). Support gases **shall be permitted to be piped into areas intended for any medical support purpose** and, if appropriate to the procedures, to be piped into laboratories.

5.1.13.1.2 Support gas sources shall be permitted to be used for many general utility uses (e.g., to remove excess moisture from instruments before further processing, or to operate gasdriven booms, boom brakes, pendants, or similar applications). (See Chapter 8 for general utility systems requirements.)

5.1.13.3.4.5 Instrument air compressors shall be permitted to be of any type capable of the **output pressure needed for the intended line pressure** see Table 5.1.1.1, and of providing air meeting the definition of instrument air in 5.1.13.3.4.1.

8.3.5 Nonmedical Compressed Air.

8.3.5.2 Nonmedical compressed air shall not be used for **powering medical instruments** or for human respiration.

8.3.5.3 Nonmedical compressed air shall meet the quality and pressure requirements of the equipment connected to the system.

Medical Air Uses in the Hospital

- NFPA allows for “Human Respiration Only” – **no tools, endo scope cleaning, booms brakes etc.**

Examples of Human Respiration Equipment:

- Blenders (NICU)
- Ventilators (ICU & Med Surge)
- Anesthesia (OR)
- Respiratory Breathing Treatments



Medical Air Intake Piping

(1) Hard-drawn seamless copper tube in accordance with the following:

- (a) ASTM B88, *Standard Specification for Seamless Copper Water Tube*, copper tube (Type K, Type L, or Type M)
- (b) ASTM B280, *Standard Specification for Seamless Copper Tubing for Air Conditioning and Refrigeration Field Service*, copper ACR tube
- (c) ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*, copper medical gas tubing (Type K or Type L)

(2) Stainless steel tube in accordance with the following:

- (a) ASTM A269/A269M, TP304L or 316L, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*
- (b) ASTM A312/A312M, TP304L or 316L, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*
- (c) A312 TP 304L/316L, Sch. 5S pipe, and A403 WP304L/316L, Sch. 5S fittings

(A) The medical air compressors shall draw their air from a source of clean air.

(B) The medical air intake shall be located a minimum of 7.6 m (**25 ft**) from ventilating system exhausts, fuel storage vents, combustion vents, plumbing vents, vacuum and WAGD discharges, or areas that can collect vehicular exhausts or other noxious fumes.

(C) The medical air intake shall be located a minimum of 6 m (**20 ft**) above ground level.

(D) The medical air intake shall be located a minimum of 3.0 m (**10 ft**) from any door, window, or other opening in the building.

(E) If an air source equal to or better than outside air (e.g., air already filtered for use in operating room ventilating systems) is available, it shall be permitted to be used for the medical air compressors with the following provisions:

- (1) This alternate source of supply air shall be available on a continuous 24-hour-per-day, 7-day-per-week basis.
- (2) Ventilating systems having fans with motors or drive belts located in the airstream shall not be used as a source of medical air intake.

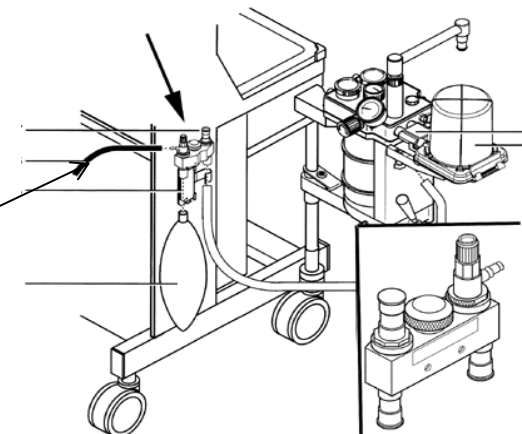


Vacuum & WAGD - Application

- Suction is used to remove fluids from the patient either during surgery or at bedside
- Evacuation “Waste Anesthetic Gases” (i.e. Nitrous Oxide & other anesthetic agents) used for scavenging the patient “breath off gas” during general anesthesia



*Purple hose from WAGD Inlet
connected to scavenging system*



WAGD & Vacuum- Review

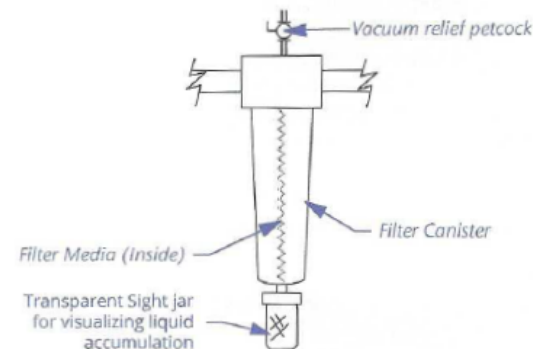
For Medical Vacuum pumps with oil, assure that the level of oxidizers are no more than 23.5% (Oxygen + Nitrous Oxide)

... or use pump technologies where these gases do not come in contact with potentially high levels of oxidizers



Vacuum Pump Inlet Filters

- *Central vacuum supply systems shall provide inlet filtration*
- *International standards have required bacteria filtration for years*
- *Vacuum systems may not be a vehicle for transmission of viable bacteria from patients to the environment due to it's lack of oxygen, moisture, copper, pump heat, and vacuum expansion. So far, only informal studies have been completed.*
- Filters must be a minimum of duplex or one per pump with isolation valves on both the patient and source side.
- Efficient to 0.03 μm and 99.97 % HEPA or better.
- It is permitted to group multiple central vacuum supply inlet filters into bundles to meet required flow capacities
- Must have a means for the user to observe any accumulation of liquids & a vacuum relief petcock.



Vacuum Exhaust Piping

5.1.10.2.1 Tubes for Vacuum. Piping for vacuum systems shall be constructed of any of the following:

(1) Hard-drawn seamless copper tube in accordance with the following:

- (a) ASTM B88, *Standard Specification for Seamless Copper Water Tube*, copper tube (Type K, Type L, or Type M)
- (b) ASTM B280, *Standard Specification for Seamless Copper Tubing for Air Conditioning and Refrigeration Field Service*, copper ACR tube
- (c) ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*, copper medical gas tubing (Type K or Type L)

(2) Stainless steel tube in accordance with the following:

- (a) ASTM A269/A269M, TP304L or 316L, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*
- (b) ASTM A312/A312M, TP304L or 316L, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*
- (c) A312 TP 304L/316L, Sch. 5S pipe, and A403 WP304L/316L, Sch. 5S fittings

5.1.3.7.2 The exhaust shall be located as follows:

- (1) Outdoors
- (2) At least 7.5 m (25 ft) from any door, window, air intake, or other openings in buildings or places of public assembly
- (3) At a level different from air intakes
- (4) Where prevailing winds, adjacent buildings, topography, or other influences will not divert the exhaust into occupied areas or prevent dispersion of the exhaust



Auxiliary Valves

- Auxiliary source connections are required only for cryogenic fluid central supply systems & oxygen concentrators

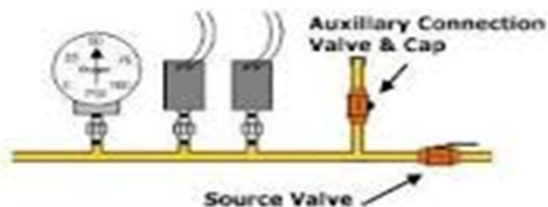
First appeared in 2015 and applied to all source equipment (manifolds, med air compressors, & vacuum pumps)

5.1.3.5.7 Auxiliary Source Connection. All cryogenic fluid central supply systems shall be provided with an auxiliary source connection point of the same size as the main line, which shall be located immediately on the patient side of the source valve.

5.1.3.9.2 Arrangement and Redundancies. Oxygen central supply systems using concentrator(s) shall be permitted to consist of two or three supply sources, as follows:

(12) An auxiliary source connection shall be provided complying with 5.1.3.5.7.

NFPA 99 , 2015 Change



Zone Valve Installations - Review

Wall intervenes between valve & outlets/inlets that it controls

Valve serves only areas on same story/floor

Outlets may not be in the same room as their zone valve

Must be readily operable from a standing position

No zone valves in series or in loops

Gauge on patient side of valve

Visible & accessible at all times

Not hidden from view (behind open or closed doors)

Not located in closed or locked rooms, areas, or closets

Immediately outside each vital life-support, critical care, & anesthetizing location of moderate, deep or general sedation

Shutting valve to any one operating room or anesthetizing location will not affect the others

Frangible or removable covers

Psychiatric or pediatric areas, permitted to be secured with approval of AHJ



Zone Valve Labels

- Zone valve labels are required to be visible from outside of the enclosure

- Examples:

- outside of the assembly
- inside the assembly but visible from outside
- both inside and outside of the assembly

- May not be affixed to the removable cover

- 2012 – every room number is not required on the zone valve control label



Shutoff Valves Friction Loss

- New or replacement valves shall have a minimum Cv factor

*The **flow** coefficient, or **Cv**, is a universal capacity index and is simply defined as “the number of US gallons of water per minute at 60F that **will flow** through a valve with a pressure drop of one **psi**”*

N Table 5.1.4.1.6(a) Positive Pressure Gases

Valve Size (in.)	Minimum Cv (full open)
1/2	17
3/4	31
1	60
1 1/4	110
1 1/2	169
2	357
2 1/2	390
3	912
4	1837

N Table 5.1.4.1.6(b) Vacuum and WAGD

Valve Size (in.)	Minimum Cv (full open)
3/4	31
1	60
1 1/4	110
1 1/2	169
2	357
2 1/2	196
3	302
4	600
5	1022
6	1579
8	3136

Outlets & Inlets

- Outlets & Inlets that are facing downward must be DISS

It would be inconvenient to have DISS stations on columns & quick connect stations on walls – it would be better to use DISS stations throughout the entire OR suite.



FGI 2018 – Medical Air and Vacuum

NOTES FROM FGI 2018 REGARDING TABLE 2.1-3

Medical air outlets may be required in patient rooms C-Section & LDRP and requires medical gas/vacuum service for both infant resuscitation and mother.

4 bassinets may share one outlet that is accessible to each bassinet

If Phase II recovery is combined with PACU, three vacuum inlets per bed are required

Endoscopy processing decontamination & clean rooms must provide vacuum and/or instrument if “needed for the cleaning methods used”

In General Support Facilities (e.g. autopsy, endo processing) the use of portable equipment in lieu of a piped gas system shall be permitted

Requiring an Instrument Air outlet will be a problem hospitals without an existing system

Nonmedical compressed air, rather than Instrument Air, is appropriate for boom brakes, SPD, endoscopy processing, etc. per NFPA 99 No mention of Nitrogen used as a support gas instead of Instrument Air

NFPA 99 states that Vacuum must be used for patient care 5.1.14.1.4*

- The medical–surgical vacuum and WAGD systems shall not be used for nonmedical applications (e.g., vacuum steam condensate return).



Medical Gas Supply Hoses

Hoses or flexible connectors used in manufactured assemblies must be labeled per 5.1.6.9 to include:

- **NAME OF GAS OR VACUUM**
- **PROPER COLOR CODE PER TABLE 5.1.11**
- **OPERATING PRESSURE (IF DIFFERENT THAN STANDARDS FROM TABLE 5.1.11)**
- **INSTALLATION DATE**



Medical Gas Piping Locations

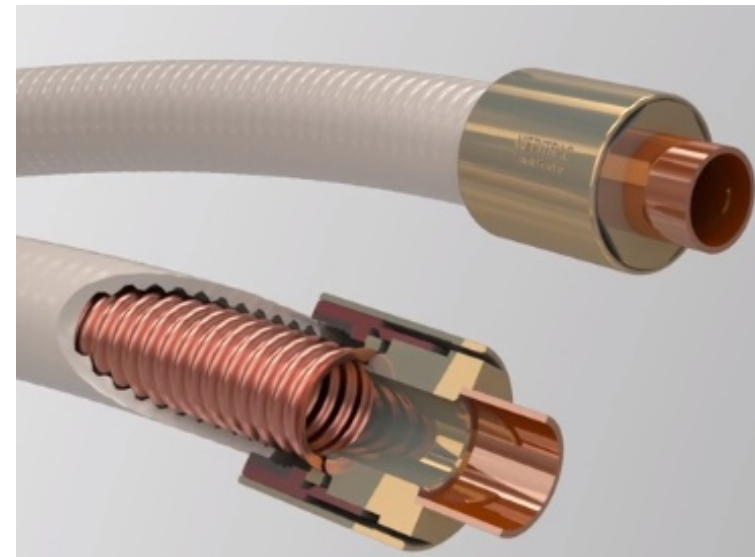
- Medical gas piping is prohibited in stairwells
- 5.1.10.11.3.1 added stairwells to the list



Corrugated Medical Tubing (CMT)

- Corrugated Medical Tubing (CMT) ASTM B103/B103M is permitted for field installed medical gas, vacuum, & WAGD tubing
- The installer of a CMT distribution system must be qualified as an ASSE 6010 Medical Gas Installer only
 - Brazing qualification not required
- T-Drills are not permitted with CMT systems
- Turns, offsets, and other changes in directions for a CMT medical gas distribution system must be made by bending up to the minimum bend radius

While CMT is probably limited in application, it was demonstrated that it could meet the necessary fire resistance, burst pressure and cleanliness, and thus has been added to the code as an acceptable material within the limits specified.



Flexible Joints

- Metallic flexible joints are permitted to be concealed in walls, ceilings, or partitions
- Bronze, copper, or stainless steel
- Cleaned for oxygen
- Suitable for 300 psig service & able to withstand 1000°F
- Extensions for brazing
- Supported hangers for their additional weight
- Reference: 5.1.10.11.6.4



Source Labeling

- Source equipment shall be labeled or tagged to identify
- Name of the gas or vacuum system using the proper color code
- Rooms, areas, or buildings served
- Emergency contact info for those responsible for maintaining the equipment



Medical Gas Installer Testing

- The 24-hr pressure test by the installer may drop 0.5%

- 2015 & prior code editions allowed no loss of pressure

Code allows for 1% drop for flexible hoses (columns, headwalls etc.)

Conflict: The installer standing pressure test must include the hoses on manufactured assemblies

How does the installer pass the standing pressure test if the hoses lose pressure?



Bulk & Microbulk Verification Credentials

- Verification testing of a cryogenic fluid central supply system shall be conducted by ASSE 6035 Verifier



Installation Inspections - New

- System inspections **shall** be performed by a(n) ASSE 6020 Medical Gas Systems Inspector or ASSE 6030 Medical Gas Systems Verifier **prior** to concealing piping distribution systems in walls, ceilings, chases, trenches, underground, or otherwise hidden from view.
- Per NFPA Medical Gas Inspections include
 - Witnessing of the initial pressure tests (may be done by 6020, 6030, AHJ, or AHJ designee)



Medical Gas Usage

- Medical gases may serve simulation centers for education of health care professionals as well as patient care needs
- This opens the door for the same piping network and source to serve patient needs and outlets used for educational purposes
- Formerly the code would require one system for patients and one for educational use



Dental Systems

*Former Category 3 systems were moved to the new
Dental Chapter 15*

*This should resolve application of category 3 codes
(intended for dental systems) into the design of
non-dental systems*



Codes That Cannot Be “Grandfathered”

- Potential fire/explosion hazards
- Labeling of Tanks & Manifold Rooms
- Cylinder & Container Handling & Locations
- Manifold Room Ventilation & Temperatures
- Medical Air Usage – only human respiration
- Equipment Maintenance, Labeling, Inspections, personnel qualifications

