NFPA 99 Standard Discussion

Fundamental changes in the categorization of health care facilities

Design changes in distribution and installation of medical gas systems

Common medical gas system installation oversights
The 2012 Edition of the NFPA 99 was promoted from a standard to a code and shall now be referred to as the Health Care Facilities Code. The code is now intended for incorporation into law by itself and not by reference from the NFPA 101 life safety code. This should help to alleviate the confusion between parties referencing different standards during the design, installation, testing and credentialing of the medical gas distribution systems.
NFPA 99 and CMS

The Center for Medicare and Medicaid Services recently adopted and instituted the NFPA 99 – 2012 Edition. Other entities such as the Joint Commission, AAAHC and DOH are in the process of following suite.
Medical gas systems were previously categorized by “levels” based on the decision trees referenced in the occupancy chapters.

Medical gas systems are now referenced by “categories” based on the health care facility’s interpretation of the risk involved to the patient and caregiver.
Medical gas systems were previously categorized by “levels” based on the decision trees referenced in the occupancy chapters.

Medical gas systems are now referenced by “categories” based on the health care facility’s interpretation of the risk involved to the patient and caregiver.
(1) **Category 1:** Systems are expected to work or be available at all times to support patient needs.

*4.1.1 Facility systems in which failure of such equipment or systems is likely to cause major injury or death of patient or caregivers shall be designated to meet Category 1 requirements.*

(2) **Category 2:** Systems are expected to provide a high level of reliability; however, limited short durations of equipment downtime can be tolerated without significant impact on patient care. Category 2 systems support patient needs but are not critical for life support.

*4.1.2 Facility systems in which failure of such equipment is likely to cause minor injury to patients or caregivers shall be designed to meet Category 2 requirements.*
(3) **Category 3**: Normal building system reliabilities are expected. Such systems support patient needs, but failure of such equipment would not immediately affect patient care. Such equipment is not critical for life support.

4.1.3 *Facility systems in which failure of such equipment is not likely to cause injury to patients or caregivers, but can cause discomfort* shall be designed to meet Category 3 requirements.

(4) **Category 4**: Facility systems in which failure of such equipment would have no impact on patient care shall be designed to meet system Category 4 requirements as defined in this code. *No potential of patient risk.*
Category 1: Loss of medical gas could cause death or major injury.
NFPA 99 Medical Gas Systems – Categorization

Category 2 – Loss of medical gases could cause minor injury.
NFPA 99 Medical Gas Systems – Categorization

Category 3 – Loss of medical gas could cause patient discomfort
Medical Gas System Categorization...Continued
Classification of Patient Care Rooms Within a Health Care Facility

• 3.3.138.1 * Basic Care Room. Room in which the failure of equipment or a system is not likely to cause injury to the patients or caregivers but can cause patient discomfort (Category 3).

• 3.3.138.2* Critical Care Room. Room in which failure of equipment or a system is likely to cause major injury or death of patients or caregivers (Category I).

• 3.3.138.3* General Care Room. Room in which failure of equipment or a system is likely to cause minor injury to patients or caregivers (Category 2).

• 3.3.138.4* Support Room. Room in which failure of equipment or a system is not likely to have a physical impact on patients or caregivers (Category 4).
Classification of Anesthetizing Levels

Awake (Normal)
Minimal Sedation
Moderate Sedation
Deep Sedation/Analgesia
General Anesthesia
Dead
General Anesthesia

A drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired.

Zone Valve & Area Alarm Required
Deep Sedation/Analgesia

A drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully following repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired.

**Zone Valve & Area Alarm Required**
Moderate Sedation

A drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation.

**Zone Valve & Area Alarm Required**
Minimal Sedation

A drug-induced state during which patients respond normally to verbal commands.

**Zone Valve Required, Area Alarm Suggested**
What does all this mean for new installations?

“3.3.65 Governing Authority. The person or persons who have the overall legal responsibility for the operation of a health care facility.”

The Design Engineer is responsible for consulting with the “Governing Body” in order to evaluate and determine room designations based on risks.
New:
Outdoor enclosures for medical gas sources must now have two egress gates.

Controls such as regulators, gauges, valves etc., can be mounted remotely from the source equipment if all other rules are observed.

Underground alarm wiring can be run as a single set of wire per signal.

Manifold: A device for connecting the outlets of one or more lines to the central piping system for that specific gas.
EOSC and In-Building Reserve Equipment

Requirement for clearance of 3 ft. around all bulk system serviced elements including the EOSC.

In-building emergency reserves shall consist of either of the following:

(1) Gas cylinder header per 5.1.3.5.9 with sufficient cylinder connections to provide for at least an average day's supply with the appropriate number of connections being determined after consideration of the delivery schedule, the proximity of the facility to alternate supplies, and the facility's emergency plan.

(2) Manifold for gas cylinders complying with 5.1.3.5.10.
Manifold Locations

Limitations for “non” or “limited” combustible materials are more clearly defined pertaining to racks for cylinder storage. No wooden racks.

Electrical devices such as light switches & outlets must be protected.

Natural or Mechanical ventilation must be provided for indoor locations.

Temperature minimum for CO2 & N2O is reduced to -20 F.
Cylinders for Manifolds

Cylinders (both empty and full) must be secured.

NFPA allows cylinders to be ganged together and secured. The AAAHC mandates that cylinders must be individually chained.

In no case other than instrument air compressors with cylinder reserves may cylinders be stored with motor driven equipment.
Medical Air Source

New:
The medical air intake is now required to be at least 25 feet from any exhaust or vent, 25 feet away from “where noxious fumes may collect” and 10 feet from any window.

Material for medical air intake piping may now be various grades of copper or stainless tube.

Joining may now include brazing, welding or axially swaged.
Medical Air Dryers

Medical Air Dewpoint Summary

Refrigerant and desiccant air dryers are both technologies capable of achieving the pressure dewpoint requirement at the supply pressure of 50-55 psig. The low-flow characteristics of hospitals, normally 33% load, makes it a challenging application for many refrigerated dryer designs due to issues with the moisture separators. As a result, the healthcare market has moved towards desiccant air dryers and is considering new technical advancements with membrane air dryers.

Summary: Install desiccant dryers whenever possible!
Medical Vacuum and WAGD Systems

5.1.3.8.1.2 If WAGD is produced by the medical vacuum source the following shall apply:

(1) The medical-surgical vacuum source shall comply with 5.1.3.7. (Oil-Free)

(2) The total concentration of oxidizers (oxygen and nitrous oxide) shall be maintained below 23.6 percent, or the vacuum pump shall comply with 5.1.3.7.2.1. (Constructed of materials deemed suitable by the manufacturer)

(3) The medical-surgical vacuum source shall be sized to accommodate the additional volume.
Medical Vacuum and WAGD Systems

New:
Vacuum must exhaust away from public places.
Vacuum exhaust can be made of various grades of copper or stainless steel.

PVC is not acceptable!
Local Alarms

5.1.9.5* Local Alarms. Local alarms shall be installed to monitor the function of the air compressor system(s), medical-surgical vacuum pump system(s), WAGD systems, instrument air systems, and proportioning systems.

*Local Signals are located at the source equipment and are monitored at the master panels.*
Master Alarms

5.1.9.2* Master Alarms. A master alarm system shall be provided to monitor the operation and condition of the source of supply, the reserve source (if any), and the pressure in the main lines of each medical gas and vacuum piping system.

Two panels are required for Category 1 Building Systems. Only 1 panel for Category 2.
5.1.9.3* Area Alarms. Area alarm panels shall be provided to monitor all medical gas, medical/surgical vacuum, and piped WAGD systems supplying the following:

- Anesthetizing locations where moderate sedation, deep sedation, or general anesthesia is administered

- Critical care areas (ED, ICU, NICU, OR, PACU, PRE-OP etc...)
Area Alarms - Location

5.1.9.3.1 Area alarm panels should be placed in a location that will most closely fulfill the following criteria (recognizing that no existing location might fulfill all criteria):

- (1) Near or within the location where the staff will most often be present
- (2) Where the audible alert will best carry throughout the unit being monitored.
- (3) Where the panel is visible from the largest number of rooms, beds, or stations within the zone
- (4) Where visualization of the panel will not be blocked
- (5) At a height above the floor at which the panel can be comfortably viewed and at which the mute button can be conveniently accessed.

- Per the NFPA 99 2012 Edition
Sensors and Alarm Communication

All pressure-sensing devices and main line pressure gauges downstream of the source valves shall be provided with a gas-specific demand check fitting to facilitate service testing or replacement.

Methods other than wiring from sensors to panels are recognized. However, the basic requirement still holds true: if communication is interrupted, an alarm must initiate.
Sensors

5.1.9.3.5 Area alarm panels for medical gas systems shall provide visual and audible indication in the event a mismatch occurs between the transducer(s) and its associated circuit board(s).

Prevents an electrical cross connection.
Valves and Valve Arrangements

1.) Source Valve
2.) Main Line Valve
3.) Riser Valve
4.) Service Valves
5.) Zone Valves
6.) In-Line Valves
7.) Future Valves
Valves and Valve Arrangements

Source Valve – Shall be placed at the immediate connection of each source system to the piped distribution system.

Main Line Valve – Shall be located immediately inside the building which it serves.

*Main line valve is not needed if the source valve is located inside the building served.*
Valves and Valve Arrangements

Riser Valve – Required at every point the main line turns up through a floor and where the main line tee’s through a floor.

Service Valve – At least one is needed before EVERY zone valve box on each floor. Highly beneficial for isolation and shut downs.

In line Valve – Installed downstream of the zone valve box. Should be considered in critical care areas for both future shutdowns and outlet replacements.
Zone Valve Boxes

Zone Valves - All station outlets/ inlets shall be supplied through a zone valve as follows:

The zone valve shall be placed such that a wall intervenes between the valve and outlets/ inlets that it controls.

The zone valve shall not be located in a room or within the line of sight of outlets which it controls.
Medical Gas Distribution System
Oversights

Zone Valve Box
Discrepancy:

Issue:
Zone Valve Box is located in an exam room behind a locked door.
Medical Gas System Oversights

Zone Valve Box
Discrepancy:

Issue:
Zone Valve Box is located in an open PACU within the line of sight of the terminals which it serves.
Medical Gas Systems: Installation Oversights

Zone Valve Box
Discrepancy:

Issue:
Zone Valve Box is located in a restroom.
5.1.3.5.2 Permitted Locations for Medical Gases. Central supply systems and medical gas outlets for oxygen, medical air, nitrous oxide, carbon dioxide, and all other patient medical gases shall be piped only into areas where the gases will be used under the direction of licensed medical professionals for purposes congruent with the following:

1. Direct respiration by patients
2. Clinical application of the gas to a patient, such as the use of an insufflator to inject carbon dioxide into patient body cavities during laparoscopic surgery and carbon dioxide used to purge heart-lung machines
3. Medical device applications directly related to respiration
4. Power for medical devices used directly on patients
5. Calibration of medical devices intended for (1) through (4)
Medical Air Outlets – Non Permitted Locations

Medical air is prohibited from being installed in the following locations:

a. Soiled Utility / Decontamination Rooms
b. Laboratory
c. Pharmacy
d. Sterilization
e. Central Supply

These areas should be utilizing another source such as instrument air or other compressed air sources.
Vacuum Inlets – Non Permitted Locations

Medical vacuum is prohibited from being installed in the following locations:

a. Soiled Utility / Decontamination Rooms
b. For use with Laser Plume

If vacuum is required in these areas it shall be produced from a system separate from the medical vacuum system.
Improper Medical Gas and Vacuum Station Installations
STATION INLET & OUTLET STYLES

Medical Gas Supply Inlets & Outlets

Medical Gas Supply Adapters
2012 Edition: Medical Gas Systems - Installation

Installation procedures new to the NFPA 2012 Edition:

* *Roller deburring* is permitted. (Rolls the burr flat, rather than cutting it off)

* Permits the use of *dimplers*. This procedure mechanically limits the depth of a coupling socket allowing a shallower cup, which when properly brazed does not compromise the integrity of the joint.

* Stainless tube may be welded.

* Axially swaged fittings may be used to join stainless tubing.

* Flexible connectors in the main line are now allowed. (Ex. Seismic)

* Vacuum piping must now be tested to 150 psi along with the pressure piping.
Installation procedures new to the NFPA 2012 Edition:

*Roller deburring* is permitted. (Rolls the burr flat, rather than cutting it off)

*Permits the use of *dimplers*. This procedure mechanically limits the depth of a coupling socket allowing a shallower cup, which when properly brazed does not compromise the integrity of the joint.
Clarifications and prohibitions new to the NFPA 2012 Edition:

*New and more specific guidelines have been established for using Memory Metal Fittings.

*Push-fit connections are prohibited for use in the distribution pipeline.

*In potentially damp locations, copper tube hangers and supports that are in contact with the tube shall be plastic coated or otherwise electrically insulated from the tube.

*Hangers for copper tubing have new size requirements.

*Methods used to breach piping cannot leave particulate in the pipeline.

*The Authority Having Jurisdiction must now witness and sign off on the 24 hour installer standing pressure test.
Installation procedures new to the NFPA 2012 Edition:

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* Axially swaged fittings may be used to join stainless tubing.

* Flexible connectors in the main line are now allowed. (Ex. Seismic)

* Vacuum piping must now be tested to 150 psi along with the pressure piping.
5.1.4.11 In-Line Check Valves.
New or replacement check valves shall be as follows:

(1) They shall be of brass or bronze construction.

(2) They shall have brazed extensions.

(3) They shall have in-line serviceability.

(4) They shall not have threaded connections.

(5) They shall have threaded purge points of 1/8” in. NPT.
MEDICAL GAS SYSTEMS: COMMON INSTALLATION OVERSIGHTS

IF THE EXISTING SYSTEM CANNOT MEET THE CURRENT INSPECTION OR PERFORMANCE REQUIREMENTS DURING A RENOVATION OR ALTERATION, THE EFFECTED SYSTEM MUST BE BROUGHT UP TO THE CURRENT NFPA 99 CODE
Medical Gas Systems: Installation Oversights

Category 1 Medical Gas Manifold Installation

Missing:

Source Valve & Valve Label
Pressure Gauge
Pressure Sensor
Demand Check Valves
Duplexed Final Line Regulator
Medical Gas Systems: Installation Oversights

Category 1 Medical Vacuum Installation

Missing:

Duplexed Pump & Associated Valves & Controls for Redundancy
Medical Gas Systems:
Installation Oversights

**Vacuum System:**

**Issue:**

The vacuum system shall be in a designated mechanical room.
Medical Gas Installation Oversights

Issues:

Non-compliant valves
Soldered piping
Insufficient labeling
Insufficient purge during brazing:
This is residual copper oxide on what was a clean white sheet. A clear indication of an improper nitrogen purge during the brazing of the pipeline.

* Obtained from 1 outlet.
Plug left in Pipe:

This is a cross section of distribution where a plug was left in the system piping during the installation.

Evidence that a visual inspection of the pipe length was not performed.

Evidence that a proper purge was not confirmed before brazing.
MORE COMMON OVERSIGHTS...

1. Where there is Nitrous oxide installed a WAGD inlet shall also be installed.

2. Demand check valves shall be installed for all pressure sensors and in-line gauges. Zone valves are excluded.

3. Zone valves shall not be installed within line of site of the outlets which they serve.

4. EVERYTHING needs to be labeled (Manifold Room doors, zone valve cover plates, alarm panels, distribution piping, etc.

5. Vent lines need to be brazed, piped outside, turned down and screened.
MEDICAL GAS SYSTEMS ARE LIFE SUPPORT SYSTEMS
Questions

1.) Which version of the NFPA 99 (date) does the CMS reference?

2.) The 2012 NFPA 99 defines health care facilities as “Levels” or “Categories”?

3.) Piped medical gas systems can be either soldered or brazed. (True or False)

4.) A zone valve box can be installed within the room which it serves. (True or False)

5.) How many master alarm panels are required for a Category 1 Health Care Facility?
NFPA Code Support

- NFPA Code Questions, Annual Services, Certifications and Repair: Upstate Analytical Services, LLC
  315-727-0428
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THANK YOU!

Upstate Analytical Services