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Safe Gas Systems and Office-Based Anesthesia

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(mailto:?subject=Check out this article&body=https://www.apsf.org/article/safe-gas-systems-and-office-based-anesthesia/)

Current Trends in Outpatient Anesthesia

NFPA 99 2018 Edition			
Category Type	**Category 3**	**Category 2**	**Category 1**
Permissable Depth of Anesthesia[a]	Nitrous anxiolysis and minimal sedation	Moderate sedation	Deep sedation and general anesthesia
Zone Valves[b] **Required**	No	Yes	Yes
Zone Alarms Required	No	Yes	Yes
Master Alarm Panel	Yes[c]	Single	Dual[d]
Controls for Line Pressure	Per manufacturer	Maintain stable pressure and flow for peak demand	Maintain stable pressure and flow for peak demand
Vacuum System	Dental vacuum	Simplex[e]	Duplex,[d,e] separate from dental vacuum
Waste Anesthetic Gas Scavenging	None	Nitrous scavenging may run through dental vacuum system	Separate Waste Anesthesitic Gas Disposal (WAGD) and medical vacuum from dental vacuum
Testing and Verification	In dental offices using dental gas systems, follow local code and manufacturer specs	American Society of Sanitary Engineers (ASSE) 6030 3rd Party Verifier	American Society of Sanitary Engineers (ASSE) 6030 3rd Party Verifier
Installation	Brazed, soldered, or fitted joints	Brazed with nitrogen purge	Brazed with nitrogen purge
Reserve Gas Supply	Minimum not required	One-day reserve supply	One-day reserve supply

[a]NFPA adopts the definitions for sedation and anesthesia from the American Society of Anesthesiologists' "Continuum of Depth of Sedation" verbatim

[b]Zone Valves are mechanical shut offs for medical gas and vacuum supply lines to each anesthetizing location and each supplied zone such as the PACU. Per NFPA, pressures must be monitored downstream of the valve for each gas and upstream for each vacuum supply line (Figure 2).

[c]Limited, need not provide real time pressures, only low supply pressure

[d]2018 NFPA 99 Chapter 15 allows a simplex system in a dental office

[e]Simplex refers to a vacuum system that may have multiple vacuum sources, but cannot generate 100% of the demand independently, and therefore is not redundant. A duplex system has 100% redundancy and can operate at capacity with a single source failure.

Anesthesia Professionals and Medical Gas Systems

Anesthesia professionals are primarily trained in the operating room. Training also occurs in hospitals and ambulatory surgery centers. These facilities, even at remote sites, must comply with NFPA 99 standards. As professionals, we are not trained to deal with the technicalities of these medical gas systems. The authority having jurisdiction (AHJ) is often the fire marshal who is not always aware of the level of anesthesia to be provided in an office. This is especially true of dental offices, in which it is often assumed that the office will be using just nitrous oxide and a dental air system (Category 3). Compounding this problem is the fact that anesthesia professionals may mistakenly assume that dental (Category 3) systems are the same as other medical gas systems that are familiar to them. This is, in part, due to the fact that Category 3 systems are not routinely discussed in texts or training programs,[3] as these nitrous dental gas systems were not intended for sedation and/or general anesthesia. Both dental and medical gas systems must be installed by an American Society of Sanitary Engineers (ASSE) 6010 Certified Medical Gas Installer, as there are strict rules for brazing and testing these piped systems. Plumbers that are not certified medical gas installers mistakenly install some of these systems. This has resulted in medical gas line cross-overs that have resulted in several deaths in dental offices due to hypoxic gas mixtures being delivered to patients. For this reason, all systems except dental Category 3 systems, even when installed by an ASSE 6010 Certified Medical Gas Installer, must then also be independently tested and verified by an ASSE 6030 Medical Gas Verifier (who has an additional two years of training with an associated certification when compared to the ASSE 6010) prior to use.

Additional patient and staff safety concerns arise from the dental air compressors and dental vacuum systems. Dental air compressors are designed simply for driving dental surgical instruments. It is highly unlikely that these systems could be mistaken for medical air, and thus will not be discussed further. However, dental vacuum pumps are designed to operate "wet" and do not have a collection canister to prevent contamination of the vacuum line. Instead, dental suctions have a "trap" built into the dental delivery unit to prevent large debris from entering the "wet" system. In the event of regurgitation, this system clogs with debris and will immediately fail. These vacuum pumps are designed to operate at high flow but low vacuum. For example, most dental vacuums operate at 10-13 inches of mercury, whereas a medical vacuum is required to maintain a minimum of 19 inches of mercury.

The variability in fresh gas and vacuum flows may also be a patient safety issue. The variability is due to the lack of compliant source systems and engineering of the gas plumbing. Connecting anesthesia machines, through the use of both gas supply and vacuum fittings and adaptors that allow connection to a Category 3 system could potentially cause fluctuations in the fresh gas and vacuum flows to the machine. The change in vacuum flow could potentially cause increases in positive end expiratory pressure (PEEP) as vacuum levels decrease with