Anesthetic gas use program

Purpose

The Arizona State University Environmental Health and Safety Department has developed this program to protect employees at ASU who have the potential for an occupational exposure to anesthetic gases. Inhaled anesthetics include two classes of chemicals: Nitrous Oxide and Halogenated agents. Halogenated anesthetic gases include: Halothane, Isoflurane, Sevoflurane, Desflurane, Enflurane and Methoxyflurane.

This guidance document is intended to ensure compliance with federal, state and local requirements. Presently, the Occupational Safety and Health Administration has not adapted a regulation regarding Waste Anesthetic Gases. OSHA requires employers to follow their General Duty Clause and has published a technical guideline, Anesthetic Gases: Guidelines for Workplace Exposures. The National Institute for Occupational Safety and Health and the American Conference of Governmental Industrial Hygienists both recommend exposure limits for WAGs.

Scope

This program applies to all ASU employees who work with or supervise work involving anesthetic gases at ASU locations. Anesthetic gases are typically used in laboratories throughout ASU during animal surgical procedures.

Responsibilities

EHS is responsible for:

- Development, implementation and oversight of Isoflurane use.
- Ensuring compliance with all federal, state and local regulations.
- Making technical guidance and training available to employees.
- Monitoring area and personal air to determine employee exposure.
- Reporting results of all exposure monitoring to employees and management.

Deans, Directors and Chairs are responsible for:

- Compliance with the ASU Chemical Hygiene Plan and Hazard Communication Program.
- Ensuring all personnel have been trained prior to anesthetic gas use.
- Ensuring reporting results of all exposure monitoring to employees.
- Following all safety guidelines for anesthetic gas use.
- Maintain Anesthetic gas equipment.
- Reporting any chemical spills, releases or emergency response through the ASU Emergency Response Guide process.

Ensuring completion of the incident reporting process for any health or safety-related incidents

Employees are responsible for:

- Completing the anesthetic gas safety training course.
- Conducting leak checks on anesthetic machines before use.
- Ensure reporting of any health or safety concerns to your management.
- Ensuring a WAG scavenge system such as a chemical fume hood, a vacuum line out of the building, a down draft table or an exhaust ducted biosafety cabinet is used when using a bell jar or any other anesthesia induction method that releases anesthetic gases into the procedure area.
- Ensuring the WAG scavenging system is used with all anesthetic gas machines.
- Following all safety policies, guidelines and department Standard Operating Procedures for anesthetic gas use.
- Following the ASU Chemical Hygiene Plan and Hazard Communication Program.
- Inspecting all equipment prior to and after each use.
- Reporting any chemical spills or releases to EHS through the ASU Emergency Response Guide spill response process and to your management.
- Reporting any problems with equipment to your management.

Capital Program Management Group Architecture, Planning and Construction is responsible for evaluating whether engineering and design intent meets current code, client's needs and best practices including but not limited to the following:

- Air change requirements are evaluated in design for the lab space.
- Capture velocity requirements.
- Conservation of energy methods.
- Discharge location for exhaust.
- Integration of system with existing building automation controls if applicable.
- Local alarm and visual indication requirements for lab spaces being negative relative to adjacent spaces.
- Secure environment proposed for using Isoflurane such as lab doors with proper locks, isoflurane bottle storage, etc.
- Supply and exhaust air distribution and design layout requirements.

Regulatory limits

Presently, OSHA has not created or adapted a regulation regarding WAG. ACGIH has a published exposure limits for WAG at 50 parts per million averaged over an 8-hour period. The following table summarizes the published recommended exposure limits.

Anesthetic gas	OSHA PEL[1] in ppm	NIOSH REL[2] in ppm	ACGIH TLV-TWA[3] in ppm
Nitrous Oxide	None	25[4]	50
Isoflurane	None	2[5]	50[6]
Halothane	None	2	50
Desflurane	None	2	None
Sevoflurane	None	2	None
Enflurane	None	2	75
Methoxyflurane	None	2	None

Footnotes

1 – PEL: Permissible Exposure Limit in ppm.

2 – REL: Recommended Exposure Limit measured as a time weighted average during the period of anesthetic gas administration which should not exceed one hour.

3 – TLV-TWA: Threshold Limit Value is the time weighted average. This value refers to an 8-hour workday and a 40-hour work week.

4 – Measured as a TWA over the period of anesthetic gas administration.

5 – Recommended ceiling limit concentration of no greater than 2 ppm over a period not to exceed one hour.

6 – ACGIH has a TLV-TWA of 50 ppm for Isoflurane and 75 ppm was set for Enflurane because it is a geometric isomer of Enflurane.

Ventilation and engineering controls

An effective room HVAC system when used in combination with an anesthetic gas scavenging system should reduce, although not entirely eliminate, the contaminating anesthetic gases. If excessive concentrations of anesthetic gases are present then airflow should be increased in the room to allow for more air mixing and further dilution of the anesthetic gases. Supply register louvers located in the ceiling should be designed to direct the fresh air toward the floor and toward the workers to provide dilution and removal of the contaminated air from the operatory. Exhaust register louvers should be properly located – usually low on the wall near the floor level – in the room to provide adequate air distribution. They should not be located near the supply air vents because this will short-circuit the airflow and prevent proper air mixing and flushing of the contaminants from the room.

ASU CPMG is responsible for evaluating capture velocity requirements, verifying supply and exhaust air distribution and design layout requirements, verifying if an exhaust and scavenging system should be integrated with the existing building automation controls, verifying that air changes requirements are evaluated in design for lab space and verifying proper exhaust discharge location.

Please refer to the OSHA Anesthetic gases: Guidelines for workplace exposures for further guidelines on ventilation controls and how to reduce workplace exposures to WAGs.

Training

All employees working with or supervising work with anesthetic gases shall complete online safety training via EHS website entitled Anesthetic Gas Safety Training prior to using any anesthetic gas. For information on how to enroll in the training please refer to EHS training webpage.

All employees working with or supervising work with anesthetic gases shall complete online safety training via ASU Blackboard Suite entitled Anesthetic Gas Safety Training prior to using any anesthetic gas. For information on how to enroll in the training please refer to EHS training webpage.

The training shall consist of regulatory limits, health effects of nitrous oxide and halogenated agents, sources of exposure, WAG scavenge systems, anesthetic gas equipment inspections, risk assessments, personal protective equipment, standard operating procedures, engineering controls, work practices, administrative controls, chemical spills, air monitoring and hazard communication. The training shall be conducted upon initial assignment and whenever there is a change in process or procedure. An annual refresher shall be conducted as well.

Standard Operating Procedure

Laboratories working with anesthetic gases shall develop a Standard Operating Procedure specific to the anesthesia apparatus used in the lab. All employees working with or supervising work with anesthetic gases shall be trained how to operate the anesthesia apparatus using the SOP. An SOP example and template can be found on the EHS webpage.

Personal Protective Equipment

PPE is required to be used at all times while in the laboratory which includes but may not necessarily be limited to:

- Closed-toe shoes.
- Laboratory coats, aprons or other suitable clothing such as shirt and long pants.
- Safety goggles or face shield.

PPE required to be used at all times when handling particularly hazardous chemicals, reproductive toxins, carcinogens and sensitizers in the laboratory which includes but is not limited to:

- Appropriate gloves.
- Closed-toe shoes
- Laboratory coats, aprons or other suitable clothing such as shirt and long pants.
- Safety goggles or face shield.

Exposure monitoring

EHS can perform air monitoring to determine anesthetic gas concentrations in the work area. Two types of monitoring can be performed, personal and area. Personal monitoring is conducted at the employee's breathing zone to determine WAG exposure for the employee. The monitoring is performed using a standard size Anasorb Carbon Molecular Sieve tube and analyzed by a certified laboratory. Area monitoring is conducted in the work area to determine WAG concentrations in work areas. Comprehensive leak testing on the equipment to determine if gas is escaping from various locations in the machine shall be performed by a qualified contractor.

Preventive maintenance should be performed by trained individuals according to the manufacturer's recommendations and at intervals determined by equipment history and frequency of use.

Information

Additional information regarding the ASU Anesthetic Gas Use Program is available by contacting EHS at 480-965-1823.

References

- Anesthetic Gases: Guidelines for workplace exposures.
- ASU Chemical Hygiene Plan.
- ASU Hazard Communication Plan.
- EHS 103: Hazardous Communication Program.
- EHS 105: Personal Protective Equipment.
- EHS 108–01: Health and Safety Training.
- EHS 401: Hazardous Waste Management.
- OSHA Waste Anesthetic Gases Safety Health Topic.