**Environmental Health and Safety** 

# Anesthetic Gas Use

# Program

November 2023



# Anesthetic Gas Use Program

# Purpose

ASU Environmental Health and Safety, or EHS, has developed this program to protect ASU employees who may have been potentially exposed to anesthetic gases occupationally. Inhaled anesthetics include two classes of chemicals: nitrous oxide and halogenated agents. Halogenated anesthetic gases include halothane, isoflurane, sevoflurane, desflurane, enflurane and methoxyflurane (used infrequently).

This guidance document is intended to ensure compliance with federal, state and local requirements. The Occupational Safety and Health Administration, or OSHA, has not adopted a regulation regarding anesthetic waste gases, or WAGs. OSHA mandates that employers adhere to their "General Duty Clause" and has published a technical guideline, "<u>Anesthetic Gases: Guidelines for Workplace Exposures</u>". the American Conference of Governmental Industrial Hygienists, or <u>ACGIH</u>, recommends WAG exposure limits.

# Scope

This program applies to all ASU employees who work with or supervise work involving anesthetic gases at ASU locations, particularly in laboratories during animal surgical procedures.

# Responsibilities

**EHS** is responsible for:

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

Deans, directors and chairs are responsible for:

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



the ASU Emergency Response Guide process.

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 is used when using a bell jar or any other anesthesia induction method that releases anesthetic gases into the procedure area, e.g., a chemical fume hood, a vacuum line out of the building, a down draft table or an exhaust ducted biosafety cabinet.
- 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 <u>ASU Emergency</u> Response Guide spill response process and to your management.
- Reporting any problems with equipment to your management.

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

- Air change requirements are evaluated in the design of the lab space.
- Capture velocity requirements.
- Energy conservation methods.
- Local alarm and visual indication requirements for lab spaces being negative relative to adjacent spaces.
- Proper exhaust discharge locations.
- Secure environment proposals for using isoflurane, e.g., lab doors with proper locks, isoflurane bottle storage and many more.
- Supply and exhaust air distribution or design layout requirements.
- System integration with existing building automation controls if applicable.

# **Regulatory Limits**

Presently, OSHA has neither created nor adopted a regulation regarding WAGs. <u>ACGIH</u> has published exposure limits for WAGs, set at 50 parts per million, or ppm, averaged over an eight-hour period. The following table summarizes the published recommended exposure limits.



Anesthetic Gas	OSHA PEL <sup>1</sup> (ppm)	NIOSH REL (ppm)	ACGIH TLV-TWA <sup>2</sup> (ppm)
Nitrous Oxide (N <sub>2</sub> 0)	None	25 <sup>3</sup>	50
Isoflurane	None	None	50 <sup>4</sup>
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, ppm: parts per million.

2 TLV - TWA: threshold limit value - time-weighted average. This value refers to an 8-hour workday and a 40-hour workweek week.

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

4 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 in combination with an anesthetic gas scavenging system should reduce, although not entirely eliminate, the contaminating anesthetic gases. Increased room airflow is necessary for better air mixing and further dilution of the anesthetic gases if excessive concentrations of anesthetic gases are present. 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, in the room to provide adequate air distribution, usually low on the wall near the floor level. 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 <u>"Anesthetic Gases: Guidelines for Workplace Exposures"</u> documents 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 the EHS website entitled Anesthetic Gas Safety Training prior to using any anesthetic gas. For information on how to enroll in the training please see the <u>EHS training page</u>.



The training shall consist of the following:

- Administrative controls.
- Air monitoring.
- Anesthetic gas equipment inspections.
- Chemical spills.
- Engineering controls.
- Hazard communication.
- Health effects of nitrous oxide and halogenated agents.
- Personal protective equipment, regulatory limits.
- Risk assessments.
- Sources of exposure.
- Standard operating procedures.
- WAG scavenge systems.
- Work practices.

The training shall be conducted upon initial assignment and whenever a process or procedure changes. An annual refresher shall be conducted.

# Standard Operating Procedure

Laboratories working with anesthetic gases shall develop a standard operating procedure, or SOP, specific to the anesthesia apparatus used in the lab. All employees working with or supervising work with anesthetic gases shall be trained in how to operate the anesthesia apparatus using the SOP. An SOP example and template can be found on the EHS <u>workplace and community safety</u> web page.

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.

# Personal Protective Equipment

Personal protective equipment, or PPE, is required to be used at all times while in the laboratory or handling particular hazardous chemicals, reproductive toxins, carcinogens and sensitizers, including but not limited to:

- Appropriate gloves.
- Closed-toed shoes.
- Laboratory coats, aprons or other suitable clothing, including shirts and long pants.



• Safety goggles or face shields.

# Exposure Monitoring

EHS can perform air monitoring to determine anesthetic gas concentrations in the work area. Two types of monitoring can be performed, area and personal.

- Area monitoring is conducted in the work area to determine WAG concentrations in work areas.
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- 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 absorb carbon molecular sieve, or CMS, tube and analyzed by a certified laboratory.

# Information

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

# References

- OSHA Waste Anesthetic Gas Safety and Health Topic <u>OSHA Waste</u> <u>Anesthetic Gases Safety Health Topic.</u>
- OSHA Technical Guideline, Anesthetic Gases: Guideline for Workplace Exposures
- <u>Anesthetic Gases: Guidelines for Workplace Exposures.</u> ASU Chemical Hygiene Plan <u>ASU Chemical Hygiene Plan</u> U Hazard Communication Plan <u>ASU Hazard</u> <u>Communication Plan.</u>
- ASU EHS Hazard Communication Policy <u>EHS 103: Hazardous Communication</u> <u>Program.</u> ASU EHS Personal Protective Equipment Policy <u>EHS 105: Personal</u> <u>Protective Equipment.</u> ASU EHS Health and Safety Training Policy <u>EHS 108–01:</u> <u>Health and Safety Training.</u>
- ASU EHS Hazardous Waste Management Policy <u>EHS 401: Hazardous Waste</u> <u>Management.</u>