



## Anesthetic Gas Use at Virginia Tech

### PURPOSE

Environmental Health and Safety (EHS) developed these guidelines to protect employees and students at Virginia Tech who work with, or may be exposed to, anesthetic gases. Waste anesthetic gas (WAG) is a term commonly used when workers are exposed to anesthetic gas during a medical or surgical procedure. Inhaled anesthetics include two classes of chemicals: nitrous oxide and halogenated agents. Halogenated anesthetic gases include halothane, isoflurane, sevoflurane, desflurane, enflurane, and methoxyflurane. Halogenated anesthetics are typically clear, colorless, highly volatile liquids at ordinary temperature and pressure. Exposure to these substances can occur as vapors escape into the work environment during the anesthetic administration process. These gases possess very poor warning properties because the odor threshold may be higher than recommended exposure limits.

### SCOPE

This guideline applies to all employees who work with or supervise work involving anesthetic gases at Virginia Tech, including laboratories, animal surgeries and other procedures.

### RESPONSIBILITIES

EHS is responsible for:

1. The development, implementation, and oversight of the program.
2. Area and personal air monitoring to determine exposure.
3. Ensuring compliance with all federal, state, and local regulations.
4. Providing any necessary medical surveillance services.

Departments are responsible for:

1. Ensuring that all personnel have been trained prior to using anesthetic gases.
2. Following all safety guidelines for anesthetic gas use.
3. Maintaining and using anesthetic gas equipment in accordance with the manufacturer's instructions.
4. Reporting any liquid agent spills or releases to EHS.
5. Developing the site-specific [Hazard Communication Program](#) (non-laboratories) or [Chemical Hygiene Plan](#) (if a laboratory).
6. Reporting results of all monitoring to employees.
7. Ensuring completion of the [Employers' Accident Report](#) for any health or safety related incidents and forwarding the report to [Human Resources](#) as required.

Employees and students are responsible for:

1. Receiving required training prior to using the equipment.
2. Following all safety guidelines when working with anesthetic gases.
3. Inspecting all equipment prior to and after each use.
4. Perform leak testing in accordance with the manufacturer's instructions before each day's use.
5. Ensuring the scavenge system is used with all anesthetic gas machines.
6. Ensuring that a scavenge system (such as a fume hood, vacuum line, gas scavenging canisters, down draft table, or a ducted bio-safety cabinet) is used when using a bell jar or any other anesthesia induction method that releases anesthetic gases into the procedure area.
7. Reporting any problems with equipment to department management.
8. Reporting any liquid agent spills or releases to department management and EHS.
9. Following the Hazard Communication Program or Chemical Hygiene Plan as appropriate.

10. Reporting any health or safety concerns to department management and completing an Employers' Accident Report if an injury or exposure occurs.

## HEALTH HAZARDS

The Registry of Toxic Effects of Chemical Substances reports adverse health effects, in addition to central nervous system effects. Nitrous oxide and halogenated anesthetics have been described as tumorigens, mutagens and human reproductive effectors.

Signs and symptoms of exposure include:

**Acute Exposure:** nausea, vomiting, skin irritation, nose/throat/respiratory irritation, headache, dizziness, and drowsiness

**Chronic Exposure:** hypotension, tachycardia, respiratory depression, and elevated blood glucose levels

## EXPOSURE LIMITS

The National Institute for Occupational Safety and Health (NIOSH) has recommended that the average concentration of halogenated agents should not exceed 2 ppm (15 mg/m<sup>3</sup>) during any 1 hour period. The NIOSH Recommended Exposure Limit for nitrous oxide is 25 ppm as an eight hour time-weighted average. The Occupational Safety and Health Administration (OSHA) has not yet established a permissible exposure limit (PEL) for anesthetic gases.

## CONTROL MEASURES

### Engineering Controls

The collection and disposal of WAG in procedure rooms and non-procedure room settings is essential for reducing occupational exposures. Engineering controls such as an appropriate anesthetic gas scavenging system are the first line of defense and are the preferred method of control to protect employees from exposure to anesthetic gases. An effective anesthetic gas scavenging system traps waste gas at the site of overflow from the breathing circuit and disposes of these gases to the outside atmosphere. The heating, ventilating, and air conditioning (HVAC) system also contributes to the dilution and removal of waste gases not collected by the scavenging system or from other sources such as leaks in the anesthetic apparatus or improper work practices.

In order to reduce the risk of exposure to WAG during induction procedures for animal research, one of the following control measures should be in place during the anesthetic application process:

**First Choice:** Placement of entire gas mixing and delivery system inside a fume hood **or** use an anesthesia machine connected to a building exhaust system.

**Second Choice:** Installation of local exhaust over the Isoflurane delivery system to address a single source of anesthetic gas **or** installation of a back draft or down draft exhaust table for procedures that involve multiple sources of anesthetic gas (e.g. knockout box and procedure table).

**Third Choice:** Capture waste gas using gas scavenging canisters. This method is only recommended as a control measure under the following circumstances:

- There is no fume hood or other local exhaust system available for use.
- Leak checks are performed routinely on equipment.
- Saturation levels of canisters are checked prior to each use.
- Researchers, clinicians, and DVM students are well trained and supervised in the proper use and maintenance of the anesthetic equipment.

Note: Decreasing oxygen flow rates during anesthetic gas administration can reduce the concentration of waste gases in the work environment. For example, reducing the oxygen flow rate from 2 to 0.4 for a single mouse on a nose cone will still anesthetize the mouse while reducing the concentration of waste gases in the work environment to more acceptable levels.

### **Personal Protective Equipment (PPE)**

Gloves and lab coats as well as chemical goggles or face shields should be worn in order to prevent contact with liquid anesthetics. PPE required for this process and your work area should be documented in your PPE hazard assessment form.

Note that using respiratory protection for anesthetic gases is not recommended, because they have poor warning properties (high odor thresholds), and you may not know if your cartridge has become saturated and is no longer effective. Any employee using respiratory protection must be medically cleared and trained by EHS.

### **Work Practices**

Anesthetic gases should be stored in cool, well-ventilated areas away from direct sunlight and sources of ignition or open flames.

## **EMERGENCY EXPOSURE PROCEDURES**

**Eye Care:** If anesthetic gases come in contact with eyes, immediately flush them with copious amounts of water for at least 15 minutes, preferably in an emergency eyewash.

**Skin Care:** In the event of skin exposure, remove contaminated clothing and immediately wash the affected area with soap and water.

**If swallowed or inhaled:** In the case of ingestion, obtain medical attention immediately. If anesthetic gases are inhaled, move the victim to a source of fresh air

## **SPILL PROCEDURES**

In the event of a spill, immediately evacuate the spill area and close all doors. Go to a safe place, call EHS (231-3600 during work hours, 911 after hours) to report the spill. Secure the area and prevent people from entering until emergency response personnel arrive. Consult the Virginia Tech [Hazardous Chemical Management Program](#) for further information.

## **EXPOSURE MONITORING**

EHS can perform air monitoring to determine the anesthetic gas concentrations in the air. The two types of monitoring performed are personal and area sampling. Personal monitoring is conducted in the employee's breathing zone to determine WAG exposure for the person. The monitoring is performed using passive dosimeters, active sampling, or by screening in the breathing zone with a direct read instrument. Area monitoring is conducted in the work area to obtain WAG concentrations in work areas. EHS can also perform leak testing on the equipment to determine if gas is escaping from various locations in the machine. To request an evaluation, please contact EHS at [halogas@vt.edu](mailto:halogas@vt.edu) or by calling 231-2509.