



**UNIVERSITY OF MINNESOTA  
REQUIREMENTS FOR USE OF  
HALOGENATED ANESTHETIC GASES**

## **1. INTRODUCTION**

Isoflurane, halothane, enflurane, desflurane, and sevoflurane are common halogenated anesthetic gases that are used in animal research. Halogenated anesthetics are typically clear, colorless, highly volatile liquids at ordinary temperature and pressure. Exposure to these substances occurs when vapors escape into the work environment during the anesthetic administration process. These waste anesthetic gases (WAG) possess very poor warning properties so odor is not an adequate indication of overexposure. Nitrous oxide is not covered by these requirements because it is not typically used in animal research. During preapproval review of an IACUC application, DEHS staff will review safety measures for using nitrous oxide with the PI.

## **2. HEALTH HAZARDS**

The Registry of Toxic Effects of Chemical Substances reports adverse health effects in addition to central nervous system effects. Halogenated anesthetics have been described as tumorigens, mutagens and human reproductive effectors. Health hazard information is available by subscription from the U of M domain at <http://ccinfoweb.ccohs.ca/rtecs/search.html> or from the Toxnet database at <http://toxnet.nlm.nih.gov/>

## **3. EXPOSURE LIMIT**

The National Institute for Occupational Safety and Health's (NIOSH) recommended exposure limit of 2 ppm averaged over any 1 hour period is the University of Minnesota Exposure Limit for any halogenated anesthetic gas<sup>1</sup>.

## **4. VENTILATION REQUIREMENTS**

When using any halogenated anesthetic gas, the following ventilation requirements must be instituted.

- a. Use only in a well ventilated area such as a laboratory or operating room
- b. Use only with suitable local exhaust ventilation or appropriate waste anesthetic gas scavenging equipment
- c. Use one of the following local capture exhaust ventilation devices that exhaust to the outside of the building and do not recirculate to supply fans or other indoor spaces:
  - i. Fume hoods
  - ii. downdraft tables; or
  - iii. 100% exhausted biosafety cabinets (Class II, Type B2)

## **5. OTHER REQUIRED CONTROL MEASURES**

- a. **The following administrative controls are required:**
  - i. Lab managers and PIs must fully implement their laboratory Safety Plan

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<sup>1</sup> The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit was established for halothane. However, given the similarity of all halogenated anesthetic gases, the halothane limit will apply.

- ii. Standard operating procedures must be developed to describe set up, use and maintenance of anesthesia systems
  - iii. The Department's Laboratory Safety Plan must be communicated to employees
  - iv. Document training received by workers initially and annually
- b. The following Engineering Controls are required:**
- i. Induction chambers (knock-out boxes) require local exhaust ventilation such as a fume hood in order to achieve adequate control of waste anesthetic gases
  - ii. Anesthetic vaporizers (reservoirs) must be calibrated annually. Inspectors will verify compliance with calibration requirements through periodic inspections.
  - iii. Anesthetic vaporizers must be filled in a fume hood or by using a keyed filling system
  - iv. Anesthetic gas delivery systems must be placed inside a fume hood; except under the following conditions:
    - 1. The anesthesia machine is connected to a building exhaust system;
    - 2. Local exhaust ventilation (such as the system is shown in the photo to the right) is provided over the isoflurane delivery system; or
    - 3. Work is done on a back draft or down draft exhaust table
  - v. Intubate subjects when feasible to minimize anesthetic leakage. Intubation is feasible for rodents when a procedure will last more than 10 minutes.
  - vi. Use the lowest necessary oxygen flow rate and concentration of anesthetic to achieve anesthesia.
    - 1. Rodents are typically induced into stage 3 anesthesia at 5% anesthetic in O<sub>2</sub> with flow set at about 0.25 L/min of O<sub>2</sub>. Verify that your equipment is capable of this low flow rate.
    - 2. Anesthesia is often maintained at about 2% (range 1% – 3%) anesthetic but there are many variables that change conditions of anesthesia,
  - vii. **Use of absorption canisters for scavenging must be limited to situations where other means of scavenging are not practicable and the following additional requirements must be met:**
    - 1. Absorption canisters can only be used with systems which actively move the gas, eg. from a pressurized tanks or a vacuum system; systems cannot use gravity.
    - 2. Canister users keep a log of:
      - a. Tare (starting) weight of the canister
      - b. Date of first use
      - c. Subsequent use dates
      - d. Weight of the canister before use
      - e. Expiration date of canister
      - f. Nose-cone delivery systems that rely on absorption canisters are operated as follows:
        - i. Routinely checked the for leaks
        - ii. Discard canisters when gain reaches the manufacturer's limit (usually 50g)
        - iii. Use canisters according to the manufacturer's instructions



**Note: Absorption canisters with exhaust ports located on the top work better than those with the exhaust ports on the bottom. Both types of cylinders should be used in the upright position. The cylinder with exhaust ports on the bottom must be elevated to alleviate back pressure. The canister with exhaust ports on the top has been designed to minimize development of open channels through the charcoal which results in better capture.**



f/air gas scavenging canister with exhaust ports at the bottom



VaporGuard gas scavenging canister with exhaust port at the

**c. The following Personal Protective Equipment are required**

- i. Gloves, lab coats and eye protection such as chemical goggles or a face shield must be worn when pouring liquid anesthetic agents.

**Note: A keyed filling system is preferred .Respirators are not permitted as a substitute for engineering controls. Respirators are not permitted for use as the sole means to protect a worker from anesthetic gases.**

**6. TRAINING AND SOP REQUIREMENTS**

- a. PIs are responsible for training their staff who work with anesthetic gases initially before use and annually thereafter
- b. Training materials are available on the DEHS website
- c. Training must be documented and training records kept by PI for a minimum of five years
- d. PIs must submit SOPs for anesthetic gas use with IACUC protocols
- e. SOPs must be reviewed and approved before anesthetic gas use is started

**7. SCAVENGING SYSTEM APPROVALS**

DEHS will evaluate scavenging systems as part of its pre-review of IACUC protocols. IACUC protocols will not be approved until DEHS has reviewed and approved the scavenging system set up. In order to expedite the review process, PI's may submit a complete description (including pictures) of the scavenging system they will be using and must provide the last date of system

calibration. This information may be submitted on IACUC protocol Appendix G or directly to DEHS. As necessary, DEHS will work with the PI laboratory to correct any deficiencies noted. Researchers may contact DEHS at 612-626-6002 or [dehs@umn.edu](mailto:dehs@umn.edu) for advice on, or evaluation of, the anesthetic gas control systems; or to have personal exposure monitoring conducted in your work area. Anesthesia systems will be subjected to periodic onsite quality assurance inspections by DEHS staff.

## **8. EXEMPTIONS**

Requests for exemptions to any of the requirements for anesthetic gas use must be submitted in writing to DEHS and must include an explanation of why these requirements cannot be followed and how satisfactory WAG control will be achieved. Exemption requests will be approved by DEHS if it is judged that there is a valid reason for the exemption, and that appropriate alternate arrangements are in place to control WAG.

## **9. ADDITIONAL USEFUL INFORMATION**

- a. Anesthesia and Analgesia in Laboratory Animals, ed. American College of laboratory Animal Medicine
- b. Federal OSHA Fact Sheet Number 91-38 (Waste Anesthetic Gases)  
[http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=FACT\\_SHEETS&p\\_id=128](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FACT_SHEETS&p_id=128)
- c. OSHA Guidance Document – ANESTHETIC GASES: Guidelines for Workplace Exposures  
<http://www.osha.gov/dts/osta/anestheticgases/index.html>
- d. University of Minnesota Research Animal Resources  
<http://www.ahc.umn.edu/rar/anesthesia.html>
- e. For help with anesthesia delivery systems and techniques an contact Research Animal Resources (RAR) veterinarian at 624-9100
- f. For help with waste anesthetic gas scavenging system set-up contact DEHS at DEHS at 612/626-6002.