Anesthetic Gases in Animal Research

Standard Operating Procedure

Revision Date: 05/21/2020

# Description [Provide additional information as it pertains to your research protocol]

*This standard operating procedure (SOP) outlines the handling and use of anesthetic gases in animal research, including: isoflurane, halothane, enflurane, ether, and nitrous oxide. Review this document and supply the information required in order to make it specific to your laboratory. In accordance with this document, laboratories should use appropriate controls and personal protective equipment when handling animal anesthetic gases.*

## Process [Write the steps for using the chemical in your research protocol]

# Procedure Location [Provide additional information as it pertains to your research protocol]

The use of animal anesthetic gases must be performed in an area with good ventilation and controls to capture and exhaust waste anesthetic gases.

# Potential Hazards [Provide additional information as it pertains to your research protocol]

Anesthetic gas and vapor that leaks during medical or research procedures are considered waste anesthetic gases (WAG). University faculty, staff and students should be aware of the potential risks of WAG and be advised to take appropriate precautions to reduce exposures. Workers acutely exposed to excessive amounts of anesthetic gas can experience symptoms of drowsiness, headache, nausea, poor judgment and loss of coordination. Chronic symptoms of over-exposure can include liver, kidney and reproductive effects. Safety precautions include the use of an approved gas scavenging system, or using the agent inside a certified chemical fume hood.

# Engineering Controls [Provide additional information as it pertains to your research protocol]

Chemical fume hoods provide the best protection against exposure to WAG and are the preferred engineering controls when using anesthetic gases.

Another form of engineering control is a scavenging system, which collects WAG that may leak during procedures. There are two types of scavenging systems: active and passive.

* Active scavenging (preferred): suction is applied to draw WAG away from personnel to a fume hood, snorkel exhaust, or other vacuum system, such that it is either captured by an activated charcoal filter (e.g., F/Air canister) or exhausted outside the building without recirculation.
  + If the house vacuum system is used to scavenge, EHS must be consulted to ensure the ventilation system is adequate for removal of WAG.
* Passive scavenging: the animal’s exhaled air is directed through non-mechanically assisted means to an activated charcoal filter (e.g., F/Air canister). While active scavenging systems are preferred, passive scavenging may be appropriate in situations where there is limited space or other constraints.

Charcoal canisters must always be positioned upright and in such a manner that the exhaust ports are not blocked. Canisters should be placed below the level of the anesthetic gas vaporizer machine so that the heaviness of the waste gases is exploited. Immediately before using any vaporizer machine, the charcoal canister should be weighed to evaluate the remaining adsorption capacity. Record the date and weight on the side of the canister. Immediately following use, weigh the canister again and record the number of hours the canister was used next to the dated weight information. Please note that activated charcoal filters do not effectively adsorb nitrous oxide vapors. Always use an active scavenging system with nitrous oxide.

Anesthetic gases should not be used for procedures without a scavenging system. In particular, the “open-drop jar” method without scavenging poses a high risk of exposure to WAG. EHS must be consulted to conduct a risk assessment and ensure personnel are not exposed to levels of WAG above recommended limits. When EHS has approved the use of isoflurane without scavenging, a letter will be issued to the PI and must be maintained with the laboratory’s Chemical Hygiene Plan binder or another easily accessible location. The letter must be made available to IACUC inspectors upon request.

# Work Practice Controls [Provide additional information as it pertains to your research protocol]

All anesthetic agents must be clearly labeled with the full chemical name. Handwritten labels are acceptable; however, chemical formulas or abbreviations are not acceptable.

Do not permit containers to remain open on the bench top. The odor thresholds for most liquid anesthetics (except for ether) are well above permissible exposure limits. If you smell the anesthetic, the control procedures you are using are inadequate and must be re-evaluated.

Always keep the flow rate of anesthetics to the animal as low as possible during the procedure. High flow rates can increase your exposure to the anesthetic. It is also important to move the point of potential gas release as close to the exhaust system as possible to increase capture of the chemical.

There are a variety of pathways for the gas to travel besides through the filter, which has a relatively high flow resistance. WAG can leak, particularly around the animal facemask or nose cone as well as when opening and closing induction chambers. It is important to attempt to seal all leaks to ensure there is a tight fit around the animal’s nose and to flush out the induction chamber with oxygen for 10 seconds prior to unsealing the lid and retrieving the anesthetized animal. Quickly replace the lid of the chamber, and continue to run oxygen through the chamber for several minutes to help purge the WAG into the scavenger. Thoroughly clean the induction chamber immediately after each use to avoid residual WAG release into the environment (which can continue to be released for up to three hours).

The National Institute for Occupational Safety and Health (NIOSH) has a recommended exposure limit (REL) for halogenated anesthetic gases of 2 ppm as a ceiling limit (average over 1 hour). This may be below the human odor detection limit for isoflurane, so if you can smell it, the exposure level is too high. Contact EHS at (734) 647-1143 to assess your surgical suite or workspace to determine any risks of over exposure to WAG. EHS can also provide exposure monitoring to determine whether a worker may be over exposed to WAG.

Special notes concerning the use of ether:

* The use of ether is not recommended because it is flammable and a mutagen. There are restrictions concerning the use of ether with animals.
* Always handle ether in a chemical fume hood due to the flammable nature of the material. If your research does not permit the handling of ether in your fume hood, contact EHS to review the adequacy of all special ventilation.
* Ethers form potentially explosive peroxides after exposure to air and light. Since these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. Write the date received and date opened on all containers of ether. Only the quantity that is immediately needed should be ordered. Containers of ether should be discarded within 12 months of opening.

# Personal Protective Equipment [Provide additional information as it pertains to your research protocol]

Eye protection in the form of safety glasses must be worn at all times when handling anesthetic agents. Ordinary (street) prescription glasses do not provide adequate protection.

Single use nitrile or latex gloves must be worn when handling anesthetic agents as well as lab coats, closed toed shoes and pants. Additional protective clothing should be worn if the possibility of skin contact is likely.

# Transportation and Storage [Provide additional information as it pertains to your research protocol]

Halogenated liquid anesthetic agents (i.e. halothane, enflurane, isoflurane) are not flammable but do have limited shelf life. Be certain to date the chemical when it is opened and to check expiration date before use.

Always purchase the smallest quantity required for use.

# Waste Disposal [Provide additional information as it pertains to your research protocol]

Activated charcoal canisters that exceed the manufacturer’s recommended hours of use or accumulated weight (whichever comes first) must be removed from service, placed in a sealed plastic bag and disposed of as a hazardous waste.

Containers of ether must be discarded by the manufacturer’s expiration date, or within 12 months of opening the container (whichever date come first).

Contact EHS Hazardous Materials Management (HMM) at (734) 763-4568 for proper waste disposal of anesthetic agents. Also refer to EHS’s [Hazardous Waste webpage](http://ehs.umich.edu/haz-waste/) for more information about waste containers, labels, manifests, waste collection and for any other questions.

# Exposures/Unintended Contact [Provide additional information as it pertains to your research protocol]

If the employee is in need of emergency medical attention, call 911 immediately.

For a chemical exposure/injury:

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| injury type | action | notes |
| Exposure-Eyes | 1. Flush eyes for 15 minutes. 2. Seek medical attention. |  |
| Exposure-Skin | 1. Wash hands and arms with soap and water immediately. 2. Seek medical attention. |  |
| **NOTE**: If an ambulance is needed, call the University of Michigan Division of Public Safety and Security (DPSS) at 911 to request assistance. | | |

Contact EHS for advice on symptoms of chemical exposure, or assistance in performing an exposure assessment.

Report all work related accidents, injuries, illnesses or exposures to Work Connections within 24 hours by completing and submitting the [Illness and Injury Report Form](http://www.workconnections.umich.edu/employees/work-related-illness-injury/step-one/). Follow the directions on the Work Connections website [Where to go for treatment](http://www.workconnections.umich.edu/treatment.html) to obtain proper medical treatment and follow-up.

Complete the [Incident and Near-Miss Report](https://ehsa.oseh.umich.edu/EHSA/public/injuryillnesssubmit/injuryillnessinitialedit) form.

## Treatment Facilities

**U-M Occupational Health Services -- Campus Employees**Mon-Fri 7:30 am - 4:30 pm  
After hours - go to U-M Hospital Emergency Dept. -- Urgent Care Clinic  
380 Med Inn building  
1500 East Medical Center Drive, Ann Arbor (734) 764-8021

**University Health Services -- University students (non-life threatening conditions)**  
Mon-Fri 8 am - 4:30 pm, Sat 9 am - 12 pm  
Contact for current hours, as they may vary  
207 Fletcher Street, Ann Arbor (734) 764 - 8320

**UMHS Emergency Department -- after clinic hours or on weekends**  
1500 East Medical Center Drive, Ann Arbor (734) 936-6666

# Spill Procedure [Provide additional information as it pertains to your research protocol]

Ether is extremely flammable. If ether is spilled immediately assess and deactivate potential ignition sources. Be prepared for a potential fire and ensure your safety and others first.

Anticipate spills by having the appropriate clean up equipment on hand. Spill materials for anesthetic agents are designed to control the liquid portion of the spill and minimize the production of vapors. Never use paper towels on large spills of anesthetic agents because it exacerbates vapor production.

* When a spill occurs, ***personal safety should always come first***.
* Alert and clear everyone in the immediate area where the spill occurred.

For additional information regarding spill response procedures, refer to the EHS [Hazardous Waste Spill Response](http://ehs.umich.edu/hazardous-waste/spill-response/) Web page.

## Minor Chemical Spill

A **minor (small) chemical spill** is one that the laboratory staff is capable of handling safely without the assistance of safety and emergency personnel, i.e., (less than 1 Gallon or 3.5 Liters, inside a fume hood). In the event of a minor chemical spill, use the following information for a safe cleanup process.

* Alert people in immediate area of spill.
* If spilled material is flammable, turn off ignition and heat sources. Don’t light Bunsen burners or turn on other switches.
* Open outside windows, if possible.
* Wear protective equipment, including safety goggles, gloves and long-sleeve lab coat.
* Avoid breathing vapors from spill.
* Confine spill to as small an area as possible.
* **Do not wash spill down the drain**.
* Use appropriate spill kits/sorbents to absorb spill. Collect contaminated materials and residues and place in container. Contact EHS-HMM (734) 763-4568 for proper disposal.
* Clean spill area with water.

## Major Chemical Spill

A **major/large chemical spill** requires active assistance from emergency personnel. In the event of a major chemical spill, use the following information for a safe spill response process.

* Attend to injured or contaminated persons and remove them from exposure.
* Alert people in the laboratory to evacuate.
* If spilled material is flammable, turn off ignition and heat sources. Don’t light Bunsen burners or turn on other switches.
* **Call University of Michigan Division of Public Safety and Security (DPSS) at 911 immediately for assistance.**
* Close doors to affected area.
* Post warnings to keep people from entering the area.
* Have person available that has knowledge of incident and laboratory to assist emergency personnel.

# Emergency Reporting

Report all emergencies, suspicious activity, injuries, spills, and fires to the University of Michigan Police (DPSS) by calling 911 or texting 377911. Register with the [University of Michigan Emergency Alert System](http://dpss.umich.edu/emergency-management/alert/) via Wolverine Access.

# Training of Personnel

All personnel are required to complete the ***General Laboratory Safety Training*** session (**BLS025w** *or equivalent*) via [EHS’s My LINC](http://ehs.umich.edu/education/) Web site. Furthermore, all personnel shall read and fully adhere to this SOP when handling animal anesthetics.

# Certification

I have read and understand the above SOP. I agree to contact my Lab Director if I plan to modify this procedure.

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| Laboratory Director | Revision Date |

### Major Revisions (Tracking purposes only -- Do not print as part of SOP)

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| --- | --- |
| Date | Revision |
| 09-13-18 | EHS name and logo were added, updated the formatting, and revised the content under Exposure/Unintended Content (AKJ). |
| 03-01-19 | Reviewed and updated. |
| 5-21-2020 | Updated and added nitrous oxide |