



OCCUPATIONAL SAFETY AND ENVIRONMENTAL
HEALTH GUIDELINE

Subject: Anesthetic Gas Use (Research)

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This Guideline is issued by the Department of Occupational Safety & Environmental Health to provide guidance and consistency in management of anesthetic gasses in animal research operations.

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SUMMARY:

Anesthetic gases, used during research involving animals, must be properly controlled to avoid overexposure of the researcher to the chemical. Workers acutely exposed to excess 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. Anesthetics of concern include ether, nitrous oxide, and halogenated agents including: chloroform, enflurane, halothane, isoflurane, methoxyflurane and trichloroethylene.

Use of anesthetic gases requires engineering controls (typically ventilation) to remove chemicals from the workplace and prevent overexposure. This Guideline describes safe practices for the use of anesthetic gases and engineering controls necessary to protect personnel from overexposure to the chemicals.

SCOPE:

This Guideline applies to all University of Michigan personnel that use anesthetizing and euthanizing chemicals in animal research operations.

REFERENCE**DOCUMENTS:**

The following documents provide guidance, rules, and regulations that govern the use of anesthetic gasses. When questions arise, OSEH is the University authority having jurisdiction over safety practices.

- Laboratory Safety Standard (29 CFR 1910.1450)
- Criteria for a recommended standard occupational exposure to waste anesthetic gases and vapors; DHEW Pub. No. (NIOSH) 77-140, March 1977. www.cdc.gov/niosh/77-140.html
- Accreditation Guidelines from 1996 AAALAC Report (Association for Assessment and Accreditation of Laboratory Animal Care, International)

DEFINITIONS:

Chemical Hygiene Plan (CHP) is a written plan, developed and implemented by lab management, which sets forth procedures, equipment, personal protective equipment, and work practices that protect employees from the health hazards associated with the use of hazardous chemicals. In essence, it is a laboratory safety manual.

Engineering Controls are methods of controlling employee exposures by modifying the source or reducing the quantity of contaminants released into the work environment. Typical engineering controls are ventilation systems that capture the contaminant before it reaches the employee.

Material Safety Data Sheets (MSDS) are chemical information sheets produced by the manufacturer containing the following information: identification and synonyms, hazardous components, physical data, fire and explosion data, toxicity data, health effects and first aid, reactivity, storage and disposal procedures, spill and leak procedures, and protective equipment. It also contains a contact number in case of emergency.

Peroxides are a class of chemicals that may explode when subjected to heat, light, friction and impact.

Personal Protective Equipment (PPE) is a device worn by the worker to protect against hazards in the environment. Respirators, gloves, and hearing protection are examples.

Waste anesthetic gas (WAG) are anesthetic gas and vapors that leak into the surrounding room during medical or research procedures.

RESPONSIBILITY: Deans, Directors, and Department Heads

- Ensure that adequate facilities, ventilation, and equipment are provided for the safe use of anesthetic gases.
- Coordinate the implementation of recommended remedial action measures when necessary to correct health or safety deficiencies.
- Ensure an environment where Principal Investigators and other personnel are encouraged to follow this Guideline.
- Actively support this Guideline within individual units under their authority by ensuring individuals working within areas under their control have the appropriate resources to implement the procedures.

Principal Investigators/ Supervisors

- Implement procedures in accordance with this Guideline. Prepare a laboratory specific Chemical Hygiene Plan to ensure hazards and risks are identified and proper procedures are in place to control the risks. Make sure all individuals working in the laboratory are trained and familiar with the plans.
- Ensure that staff is aware of this Guideline, instructed on the details of implementation, and provided with equipment and controls. Maintain documentation of the program and training as required by the Chemical Hygiene Plan.
- Assign resources to support the implementation of this Guideline.
- Report all work related injuries and illnesses (including animal bites) to the Work Connections office within 24 hours by completing and faxing the [Illness and Injury Report Form](#) to (734) 936-1913.

OSEH

- Provide training to the Principal Investigator and Laboratory Manager upon request, and maintain records of training.
- Provide technical assistance and conduct safety audits.
- Conduct air monitoring for anesthetic gases to evaluate employee exposure. Monitoring to evaluate work conditions will be conducted initially, upon request, and after an exposure incident.

University Committee on the Use and Care of Animals (UCUCA)

- Upon request provides OSEH with a list of laboratories using anesthetizing and euthanizing gases.
- Audits use of anesthetic methods and devices.

Employees

- Comply with this guideline and any further safety recommendations initiated by the Principal Investigator, ULAM, UCUCA, or OSEH.
- Conduct assigned tasks in a safe manner, wear appropriate personal protective equipment, and only use equipment for which they have been formally trained.
- Report to the Principal Investigator any job related injuries or illnesses, health and safety concerns, and unsafe or unhealthy working conditions.
- Review chemical hazard information detailed on MSDSs before beginning work with anesthetic gases.

PROCEDURES:

The following procedures have been prepared to provide a consistent approach to the health and safety programs for animal handlers at the University of Michigan.

A. Chemical Hygiene Plan (CHP)

1. The PI/Supervisor will designate personnel responsible for preparing the [Chemical Hygiene Plan](#) for the laboratory. The CHP is required of all laboratories that handle hazardous chemicals for research purposes. Guidelines and templates are available on the OSEH website. It is advised that one individual should be assigned as a Chemical Hygiene Officer for the laboratory to make sure the documents are maintained up to date. It is the PI/Supervisor that is ultimately responsible to devise effective occupational safety protocols in consultation with ULAM and OSEH.
2. Hazards may be identified by the laboratory during preparation of the CHP and Standard Operating Procedures (SOP). The PI will work with the OSEH representative in assessing the risks and identifying equipment, PPE, or procedures to mitigate the risks. These will all be documented within the CHP specific to the laboratory, and will be available to anyone working within the area.
3. Within the laboratory setting, it is the responsibility of each PI/Supervisor to identify situations in which the potential for exposure to hazardous biological, chemical, or physical agents exists. Upon evaluation, OSEH will assume responsibility for monitoring and reporting on personnel exposure to selected hazards as needed.
4. Personnel who use anesthetic gases should be aware of the exposure symptoms associated with handling and use. If a lab worker is

experiencing symptoms, the person should seek immediate medical attention. The supervisor must then complete a Work Connections Injury or Illness Report, and contact OSEH to arrange for environmental monitoring.

B. Use of Liquid Anesthesia ,Induction Boxes and Open Drop Technique

1. Vaporizers should be filled inside of a fume hood or using local exhaust ventilation (adjustable exhaust snorkel where available). When filling is completed, ensure the liquid anesthesia bottle is closed.
2. When using an induction box, ensure that the box seals tightly. Connect the box to the scavenge system to evacuate the gas prior to moving the animal. Do not turn the gas on until the box is closed. If possible, flush the box with oxygen prior to moving the animal to reduce gas escape. If feasible, use the induction box under the fume hood or with an exhaust snorkel where available. Do not turn the machine on until the mask is connected to the animal.
3. The open drop technique is the most basic type of anesthetic delivery system. It involves the application of the anesthetic gas to an absorbent material that is then placed in the bottom of, anesthetic chamber (i.e. bell jar). Always keep the anesthetic chamber inside the hood or under an exhaust snorkel during use. Use a chamber with a tight fitting cover. Keep the lid on except when the animal is being placed into or removed from the chamber.

C. Engineering Controls

All personnel using anesthetic gases must use adequate local exhaust ventilation to minimize personal exposure. Recommended engineering controls during anesthetizing and euthanizing procedures include scavenging devices, chemical fume hoods, and snorkel hoods. Canopy hoods do not work well for this application, due to the distance from the source and the large volume of air required in capture of migrating gasses.

A preventative maintenance program which follows the UM Program for Monitoring Anesthetic Machines and Vaporizers must be implemented to reduce exposure. This should include: inspection, testing, cleaning, lubricating, and adjusting all components of the machine. It is required that a trained technician or vendor perform the tests at least annually or per the manufacturer's recommendations. Always keep documentation of the inspections.

1. Proper Use of Scavenging Equipment

The use of scavenging devices with anesthesia delivery systems is the most effective way to decrease waste anesthetic gases. When used properly, vaporizers equipped with activated charcoal canisters (e.g. F/Air) are effective in removing halogenated waste gases but, NOT nitrous oxide. This is accomplished by directing the gases from the disposal tubing through the canisters. The F/Air canister will adsorb the vapors of halogenated anesthetics. The advantage to using canisters is that they allow for portability of the equipment. The disadvantages are that they are expensive and must be changed in accordance to the instructions below. Note: F/Air canisters only adsorb halogenated anesthetics (e.g., isoflurane, halothane). They are NOT EFFECTIVE for capture of nitrous oxide.

F/Air Canister Usage

1. F/AIR canisters must be used vertically and suspended off of the table top or floor because the exhaust ports are in the bottom of the canister.
2. Immediately before using any anesthesia machine, the F/Air canister should be removed and weighed to evaluate the remaining adsorption capacity. The weight should be recorded and dated on the side of the canister.
3. Immediately following the use of an anesthesia machine, the number of hours the machine was in use should be recorded next to the dated weight information.
4. Canisters that exceed 12 hours of use or 50 grams of accumulated weight (whichever comes first) must be removed and placed in pail for disposal through OSEH HazMat (3-4568) as a hazardous waste.
5. Thoroughly clean the induction chamber immediately after each use to avoid residual anesthetic waste release into the environment (which can continue to be released for up to three hours).

2. Chemical Fume Hood and Alternative Engineering Controls

1. If a scavenging system is not available, the surgical field shall be placed inside the fume hood or use a snorkel hood whenever anesthetic gas is used. This includes gases applied with the use of nose cones, induction boxes and open drop technique.
2. Check fume hood or snorkel certification sticker date. Units should be certified annually. Ensure that the fume hood or

snorkel hood and room ventilation are in proper working order before use. Contact OSEH (3-6973) if annual certification is needed.

3. Snorkel must be located as close as possible to location of gas use. Check certification sticker on snorkel to determine the maximum distance snorkel should be located. Contact OSEH (3-6973) if certification sticker not available or for questions regarding proper use.
4. Alternative engineering controls such as chamber connection to house vacuum, ducted biological safety cabinets (e.g. Class II, Type B2), downdraft tables, may also be used to effectively control exposure to anesthetic gases during induction of anesthesia or euthanasia. Selected engineering controls must be suitable for the application and used appropriately to be effective in the protection of personnel. Investigators should consult with the OSEH for assistance in the selection, use, and evaluation of controls.

D. Restrictions on Use of Ether

1. Ether has properties that make it more dangerous to use than other anesthetics: extreme flammability, high vapor pressure, low flash point, peroxide formation, and its classification as a mutagen by NIOSH. Use of ether requires adequate exhaust ventilation, approved flammable liquid storage cabinets, and diligent lab safety procedures. Precautions include close tracking and dating of ether supplies to avoid peroxide formation. OSEH strongly recommends the substitution of ether with less volatile and less flammable anesthetics. Possible anesthetic substitutes include: halothane, enflurane, isoflurane, and methoxyflurane.
2. Ether must be stored in National Fire Protection Association (NFPA) approved flammable liquid storage cabinets or in rooms meeting Occupational Safety Health Administration (OSHA) flammable liquid storage requirements. Oxidizers, acids, and other incompatible chemicals are prohibited from being stored in these areas. Sources of ignition, such as surgical cauterizers, must not be permitted in or near work and storage areas.
3. Store ether in airtight containers in a dark, cool and dry area. **DO NOT** allow sources of heat, friction, grinding, or impact near storage areas. Due to peroxide formation, contact OSEH HazMat (3-4568) for disposal of ether over one year old or nearing the manufacturer's expiration date.

4. Ether-exposed carcasses must be stored in freezers and refrigerators made for the storage of flammable material. These units will have a factory identification plate indicating it is safe for flammable liquids storage.

E. Spills

Spills of liquid anesthetic agents evaporate quickly at room temperature. Laboratory personnel may perform the clean up of small spills (25 milliliters or less) provided that laboratory personnel have reviewed the material safety data sheet (MSDS) and the agent can be absorbed with paper toweling at the time of the release. If absorbed, the waste material shall be placed into a sealed container, labeled and referred to OSEH HazMat (3-4568) for final disposal.

In the event a spill involves more than an estimated 25 milliliters, laboratory personnel are to vacate the room immediately and secure the room from general access. Report the spill to the laboratory supervisor and contact OSEH at 3-4568.

E. Disposal

Empty containers of liquid anesthetic agents can be discarded in an uncontaminated glass waste box in the laboratory after the container has been triple rinsed and the label is defaced

Containers which still have product inside must be referred to OSEH HazMat (3-4568) for final disposal

RELATED DOCUMENTS:

The following documents provide additional guidance on the safe use of anesthetic gasses.

- OSHA guidance document - [ANESTHETIC GASES: Guidelines for Workplace Exposures.](#)
- UCUCA - [UM Program for Monitoring Anesthetic Machines and Vaporizers](#)
- Federal OSHA Fact Sheet No. 91-38 (Waste Anesthetic Gases)
- OSHA 1910.106 Flammable Liquid Storage
- NFPA 45 Fire Protection for Laboratories Using Chemicals
- NFPA 30 Flammable and Combustible Liquids Code

TECHNICAL SUPPORT:

OSEH (3-6973) provides technical support for the proper use and storage of anesthetic gases, evaluating engineering systems used to control exposures to anesthetic gases, and conducting personal exposure monitoring for laboratory workers.

The Unit for Laboratory Animal Medicine (ULAM) provides information on suitable anesthetic gasses to use in research (4-0277). Additionally, ULAM has arranged for a service provider to come on

campus twice a year to conduct inspections of anesthetic machines and vaporizers.