ADVISORY NO. 8.5: ANESTHETIC GAS USE (RESEARCH)

Summary:
Many anesthetic gases are used at the University of Cincinnati. Anesthetic gases of concern are ether, nitrous oxide, and halogenated agents, i.e. chloroform, enflurane, halothane, isoflurane, methoxyflurane, trichlorethylene, and sevoflurane. Use of anesthetic gases requires ventilation (engineering controls) to remove vapors from the workplace. This document describes safe practices for the use of anesthetic gases and engineering controls necessary to protect personnel from exposure to vapors.

Scope:
This Advisory applies to all researchers that use anesthetizing and euthanizing gases and vapors.

Reference Regulations:
Occupational Safety and Health Administration - Laboratory Safety Standard (29 CFR 1910.1450)
Accreditation Guidelines from 2025 AAALAC Report (Association for Assessment and Accreditation of Laboratory Animal Care, International)
National Institute of Occupational Safety and Health Report no. 77-140

Definitions:
Chemical Hygiene Plan (CHP) – a written program developed and implemented by laboratory management that outlines procedures, required equipment, personal protective equipment (PPE), and safe work practices designed to protect employees from the health hazards associated with the use of hazardous chemicals.

Engineering Controls – methods of controlling employee exposures by modifying the source or reducing the quantity of contaminants released into the work environment.

Safety Data Sheets (SDS) – contain the following information: substance 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. For the OSHA Brief on Safety Data sheets please see the document linked below.

https://www.osha.gov/sites/default/files/publications/OSHA3514.pdf

Exposure Limits – the maximum concentration or level of a substance (like a chemical or noise) that a person can be exposed to over a specific period without experiencing unreasonable health risks or adverse effects.

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

Responsibility:

Deans, Director, 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.
- Ensure an environment where principal investigators and other personnel are encouraged to follow this Advisory.
- Actively support this Advisory within individual units.

Laboratory Animal Medicine Services (LAMS)

- Houses anesthesia machines for use by LAMS research groups and maintains record of use and maintenance of those anesthesia machines either internally or through a contracted outside agency.

Principal Investigators

- Implement procedures in accordance with this Advisory.
- Ensure that staff is aware of this Advisory, are instructed on the details of implementation, and provided with equipment and controls. Maintain documentation as required.
- Assign resources to support the implementation of this Advisory. If there is an accident or injury, follow the guideline for injury reporting.

Laboratory Managers or Senior Research Personnel

- Ensure employees are instructed on and follow proper procedures and utilize ventilation and protective equipment provided during their work.

Environmental Health and Safety

- Provide training to the Principal Investigator and Laboratory Manager upon request and maintain records of training.

- Provide exposure monitoring and engineering controls assistance and conducts 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.

Institutional Animal Care and Use Committee (IACUC)

- Maintain a list of Research Areas that use anesthetic and euthanizing gases.
- Provide information to Environmental Health and Safety as necessary.

Employees and Students

- Comply with this Advisory and any further safety recommendations initiated by the Principal Investigator.
- 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 SDSs' before beginning work with anesthetic gases.

Procedures:

A. Standard Operating Procedures (SOP)

- Read the SDS and safety precautions for all anesthetic gases used and incorporate these precautions into the Chemical Hygiene Plan (CHP) with written Standard Operating Procedures.
- 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 an Injury Report and contact EH&S to arrange for environmental monitoring.
  For information on LAMS guidelines for anesthesia machines access the following website:

https://researchhow2.uc.edu/docs/default-source/default-document-library/rodent-anesthesia-and-system-inspection-guideline.pdf

B. Ventilation

- All personnel using anesthetic gases must use adequate local exhaust ventilation to minimize personal exposure. Recommended ventilation 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 to capture migrating gases.

C. Usage of Ether, Halothane, and Methoxyflurane

- The use of ether, halothane, and methoxyflurane as an anesthesia agent is not permitted without strong scientific justification, EH&S guidance, and IACUC review if animal research is involved – and approval of its use and handling.
- Environmental Health and Safety strongly recommends the substitution of ether with less volatile anesthetics. Possible anesthetic substitutes include: enflurane, isoflurane, and sevoflurane.

D. Gas Anesthetics

- All gas anesthetics must be used with appropriate waste gas scavenging systems.
- Inhalation anesthesia is superior to most injectable forms of anesthesia in safety and efficacy. It is easy to adjust the anesthetic depth. Because the anesthetics are eliminated from the blood by exhalation, with less reliance on drug metabolism to remove the drug from the body, there is less chance for drug-induced toxicity. Inhalation anesthetics are always administered to effect. The disadvantages to inhalant anesthesia are the complexity and cost of the equipment needed to administer the anesthesia, and the potential hazards to personnel. All inhalant drugs are volatile liquids. Volatile anesthetics such as halothane, methoxyflurane, and nitrous oxide have been reported to pose a risk to personnel who are chronically exposed to the agents. Risks include hepatotoxicity, renal insufficiency and decreased reproductive parameters. Mutagenicity has been reported but teratogenic effects have been variable, and in vivo carcinogenicity has not been demonstrated. Behavioral modifications have been reported at subanesthetic concentrations. The agents should not be stored in animal rooms because the vapors are either flammable or toxic to inhale over extended periods.

of time. In particular, ether must be stored in a proper cabinet for flammable materials.
For more information please see the OSHA safety and health topic on Waste Anesthetic Gases at the link below.
https://www.osha.gov/waste-anesthetic-gases/hazards

Inhalant Agents:

Drug	Toxicity	Comments
Ether	Liver	Flammable and can become explosive with prolonged storage. Ether must be used according to appropriate safety guidelines.
Chloroform	Carcinogen	A hazardous agent (carcinogenic) and cannot be used as an anesthetic agent at UC.
Methoxyflurane		
Halothane		
Isoflurane	Reproductive Hazard	
Enflurane		
Nitrous Oxide	Hepatotoxic	
Carbon Dioxide (CO2)	Cerebral Anoxia	Poses minimal hazard to personnel and can be used in laboratories or animal room.

- The most complicated aspect of using inhalant anesthesia is the delivery system. A more complete discussion of anesthetic delivery system is available here:

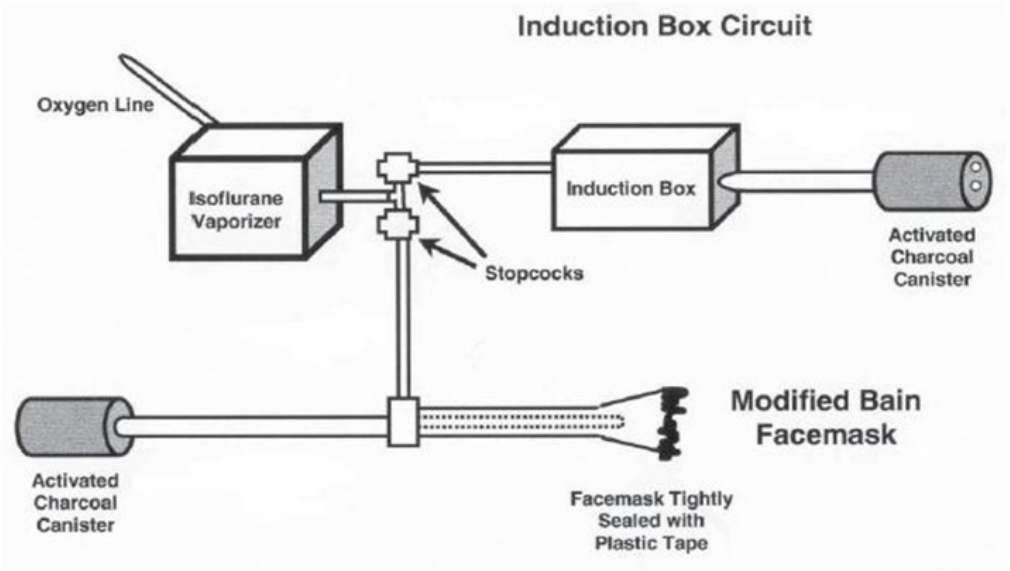
Exposure Limits:

- UC follows ALARA (as low as reasonably achievable) principle.
- Isoflurane: ≤ 50 ppm over 8 hours (ACGIH 2022).
- Other anesthetic gases: ≤ 2 ppm over 1 hour (NIOSH 1977).

- OSHA has no set PELs for halogenated anesthetic gases.

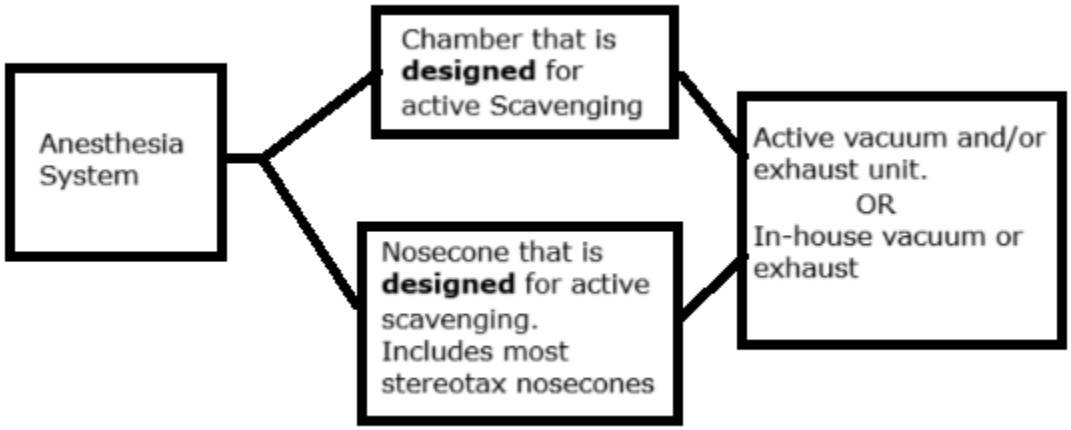
Methods for Administering Anesthetic Gases:

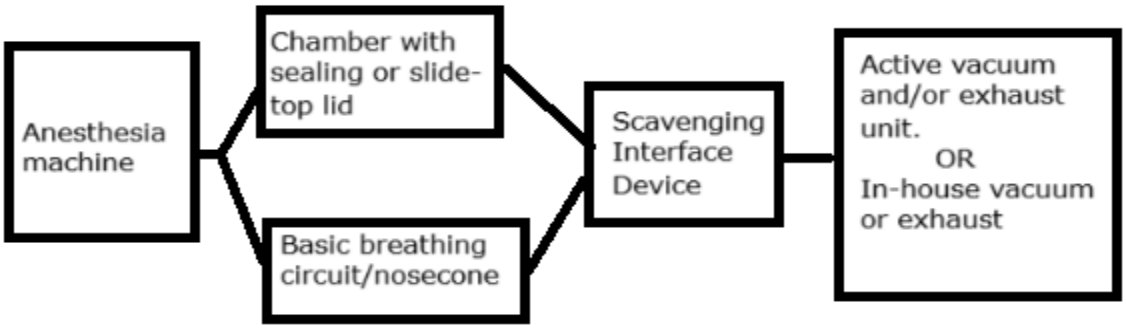
Anesthetic Machine - Passive Scavenging



Resource: Contemporary Topics American Association for Laboratory Animal Science, Vol 42, No. 2, March 2003

Anesthetic Machine - Active Scavenging





If you desire to use your existing chamber and nosecone circuits, but want to use vacuum or exhaust, you MUST put an interface between the components and the vacuum/exhaust source

The EH&S recommended method for delivering inhalant anesthetics is through the use of an anesthetic machine. These machines provide precise mixing of the anesthetic gas with air or oxygen and allow for easy adjustment of anesthetic levels.

While machines may vary in design and construction, they generally require additional training to operate safely and effectively.

Anesthesia machines must have a waste gas scavenging system equipped. Two main methods of waste gas scavenging used with anesthesia machines exist: active and passive. EH&S and LAMS recommend that anesthesia machines be equipped with an active scavenging system. If an active scavenging system is not available anesthesia administration machines must be equipped with a waste gas scavenging system with an activated charcoal canister. For more information regarding LAMS Rodent Anesthesia and System Guideline, please see the document linked below:

https://researchhow2.uc.edu/docs/default-source/default-document-library/rodent-anesthesia-and-system-inspection-guideline.pdf

Drop System

The drop system 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 an anesthetic chamber or nose cone device.

Problems with a drop system and how to deal with them

- Significant waste gas is produced. To minimize waste:
- Perform anesthesia administration in a certified chemical fume hood or alternative (e.g. snorkel exhaust dome hood) to ensure removal of waste anesthetic gases, and to minimize occupational exposure to exiting gases.
- Use a chamber with a tight-fitting cover.
- Use a chamber with the smallest diameter mouth possible.
- Keep the lid on except when the animal is being placed into or removed from the chamber.
- Add anesthetic to the absorbent material only in a certified chemical fume hood.

If you need an exposure evaluation, contact the EH&S office at 513-556-4968.

Related Documents:

Federal OSHA Fact Sheet No. 91-38 (Waste Anesthetic Gases)

OSHA Anesthetic Gases: Guidelines for Workplace Exposures

OSHA 1910.106 Flammable Liquid Storage

NFPA 45 Fire Protection for Laboratories Using Chemicals

NFPA 30 Flammable and Combustible Liquids Code

ACGIH TLV-TWAs for anesthetic gases (Isoflurane)

Exposure Monitoring:

Environmental Health and Safety (513-556-4968) will provide exposure monitoring to evaluate the proper use and storage of anesthetic gases. EH&S will conduct evaluations of engineering systems used to control exposure to anesthetic gases and conduct personal exposure for laboratory workers.