



Johns Hopkins University

Animal Care and Use Committee

Use of Anesthetic Gases: General Guidelines & Vaporizer Calibration¹

PURPOSE: The Animal Care and Use Committee (ACUC) has developed the following guidelines to control the risk of exposure to waste anesthetic gases in the workplace.

A. INTRODUCTION

Inhalant anesthetic gases (e.g., isoflurane, halothane, sevoflurane, desflurane) are halogenated gases that are commonly used in animal research. Halogenated anesthetics are typically clear, colorless, highly volatile liquids at normal temperature and pressure. Exposure to these substances occurs when vapors escape into the work environment during the anesthetic administration and recovery process.

Waste anesthetic gases possess very poor exposure warning properties, so odor is not an adequate indication of overexposure. Long-term exposure to waste anesthetic gases has been linked to genetic mutations, cancers, spontaneous abortions, hepatic and renal disease, and psychomotor changes in humans. Health hazard information is available from the NIH National Library of Medicine (NLM) PubChem at <https://pubchem.ncbi.nlm.nih.gov/>.

B. PROCEDURES TO REDUCE EXPOSURE

Equipment and system maintenance for anesthesia machines and vaporizers

1. Anesthetic vaporizers must undergo periodic calibration verification by a professional service technician as recommended by the manufacturer and be serviced if necessary.
2. If no such manufacturer recommendation exists, the following schedules apply:
 - Halothane vaporizers:** Calibration verification must be performed annually because halothane's properties lead to increased clogging of internal vaporizer components.
 - Isoflurane vaporizers:** Calibration verification must be performed at least every 3 years. If the machine is subject to extensive use (e.g., > 500 hr/year), or is frequently moved to different locations, then verification must be performed annually.
 - SomnoSuite® vaporizers:** Low-flow anesthesia system for mice and rats. No calibration verification necessary (machine comes with a no-calibration certificate).
3. To schedule vaporizer calibration and/or maintenance, call Johns Hopkins Clinical Engineering (410-502-6301), and ask for the group responsible for calibrating vaporizers.
4. A copy of the manufacturer's guidelines for calibration verification must be available in the laboratory to assist with oversight by the ACUC of proper maintenance of anesthetic equipment.
5. Documentation of equipment calibration must be affixed to each anesthesia machine or vaporizer that is in service.

Environmental controls

1. Work in a well-ventilated area such as a laboratory or operating room.
2. Handle liquid anesthetic agents in a certified chemical fume hood, hard-ducted biosafety cabinet (BSC), downdraft table, or use another suitable local exhaust system.
3. Inspect anesthesia equipment for calibration date and scavenging system set-up prior to

using the machine.

4. Personal Protective Equipment (PPE) such as gloves, lab coat, and eye protection (face shield or goggles) should be worn when dispensing liquid anesthetic agents.
5. Use a reliable gas scavenging system to collect, remove and dispose of waste anesthetic gases. Scavenging options include:
 - a. Dedicated exhaust system: A dedicated exhaust system such as an active vacuum waste gas line or an “elephant trunk” exhaust system is the preferred method to remove waste gases from the work environment.
 - b. Non-circulation ventilation systems: These discharge waste gases through an exhaust vent or grill (e.g., hard-ducted biosafety cabinet or downdraft table).
 - c. Chemical fume hood: The anesthetic can be delivered to the animal while it is inside the fume hood. Alternatively, an exhaust gas line from the anesthesia machine can be vented inside the hood.
 - d. Absorption devices: Charcoal canisters (e.g., F/Air® or Enviro-Pure®) can be used to absorb halogenated waste gases. These canisters must be properly placed so that the vent holes (typically on the bottom) are not obstructed. Usage must be documented and accompanied by the method used to determine canister life as supplied by the manufacturer. For F/Air® canisters this involves weighing the canister before and after use and discarding the canister (as hazardous waste) when there is a 50 g increase from the initial weight.
 - See information sheet below for additional types of charcoal canisters and their proper use and positioning.
 - Dispose of full charcoal canisters as chemical waste (must have a Hazardous Waste Label attached to them)
 - Waste labels are available from the Health, Safety & Environment (HSE) Office (2024 E. Monument St, Suite B200)
 - Depending on lab location, there may be a nearby chemical waste drop-off location, or labs may request a chemical pick up online: <https://mrprcbcw.hosts.jhmi.edu/redcap/surveys/?s=33PNXHLARX97MDXX>
6. Do not turn on the vaporizer until the animal has been placed in the induction chamber (or if applicable, positioned in the nose cone).
7. If the induction chamber is not used within a fume hood or BSC, purge the chamber with oxygen for 5-15 sec prior to removing the anesthetized animal.
8. If the animal is maintained on a nose cone, purge the system with oxygen for a few minutes prior to removing the anesthetized animal.

C. TRAINING REQUIREMENTS

The Principal Investigator (PI) is responsible for ensuring that staff who will be working with anesthetic gases are properly trained before independent use.

D. ADDITIONAL USEFUL INFORMATION

1. Fish, R., Danneman, P., Brown, M., Karas, A., (Eds.). *Anesthesia and Analgesia in Laboratory Animals*, New York: Academic Press (2008).
2. 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
3. OSHA Guidance Document – ANESTHETIC GASES: Guidelines for Workplace Exposures <http://www.osha.gov/dts/osta/anestheticgases/index.html>
4. For help with anesthesia delivery systems and techniques contact a Research Animal Resources (RAR) veterinarian at 410-955-3273.

[1] Approved by the Animal Care and Use Committee: October 15, 2009; reviewed 2015, 2018, 2021, 2024

COMMON CHARCOAL CANISTER USE & POSITIONING REQUIREMENTS



The **f/Air®** model charcoal canister requires upright positioning to work properly, because it ventilates through the bottom. This canister requires a rack/stand (such as the metal rack shown above in the picture to the right) to suspend it above a surface, allowing the bottom to ventilate. This canister does not function optimally if it is positioned on a solid surface (e.g., table, bench top, floor) or on its side. Record the canister weight before and after use. *Replace this canister after a 50 g increase from initial weight recorded. (**Example:** Before its first use, a canister weighs 300 g. After several uses, the canister weighs 351 g. The canister should be replaced.)



The **ReFresh®** model charcoal canister requires upright positioning to work properly, because it ventilates through the bottom. This canister requires a rack/stand (such as the metal stand shown above in the picture to the right) to suspend it above a surface, allowing the bottom to ventilate. This canister does not function optimally if it is positioned on a solid surface or on its side. *Replace this canister after a 100 g increase from initial weight recorded.



The **Breath Fresh®** model charcoal canister requires upright positioning to work properly, because it ventilates through the bottom. This canister requires a rack, stand, or mounting on a pole (such as the pole mount shown in the picture to the left) to suspend it above a surface, allowing the bottom to ventilate. This canister does not function optimally if it is positioned on a solid surface or on its side. *Replace this canister after a 50 g increase from initial weight recorded.



The **VetEquip® VaporGuard** Absorption charcoal filter (pictured to the left) does not require upright positioning. It ventilates only through the top and may be used properly whether on a solid surface or on its side. *Replace this canister after a 50 g increase from initial weight recorded.

*** All charcoal canisters must be used according to each manufacturer's safety specifications.**