| Institutional Animal Care & Use Program - UTEP | |
|---|---|
| **Title**: Isoflurane and Sevoflurane Waste Anesthetic Gas | |
| **Policy #:** 020 | **Date in Effect**: 14 January 2015 |
| **Version:** C | **Rev Date**: 15 December 2025 |
| **In Effect** ☒ **Rescinded** ☐ | **Date Rescinded**: |

A) RESPONSIBILITIES

It is the responsibility of all animal users who utilize gas anesthesia (e.g., isoflurane or sevoflurane) in laboratory animals at UTEP to abide by this policy. It is the responsibility of the IACUC to review for approval, properly justified requests for an exception to this policy.

This policy is intended to ensure compliance with the Guide for the Care and Use of Laboratory Animals, applicable OSHA and NIOSH occupational safety standards, and AAALAC International expectations for the safe use of volatile anesthetic agents in animal research. All personnel using isoflurane or sevoflurane, regardless of delivery method, must complete IACUC-approved and LARC-approved training and demonstrate documented competency prior to initial use and at intervals determined by LARC.

B) APPLICATION

1) Isoflurane is a commonly used anesthetic for many procedures in animal research facilities. This agent is delivered using a precision vaporizer or the open-drop method (a technique often used for rodents in research). Personnel using any of these methods for delivering isoflurane or sevoflurane may be exposed to waste anesthetic gases (WAG). This policy is intended to provide isoflurane and sevoflurane users with some basic guidelines for the proper use of isoflurane and sevoflurane machines; describe their basic components; describe what is needed to perform an open-drop technique; describe the availability of training to use vaporizers; and provide an explanation of the most common practices that lead to human exposure. Unless otherwise specified, the exposure-minimization practices described in this policy apply to all anesthetic delivery methods (low-flow precision vaporizers and open-drop techniques).

C) REFERENCES

1) Taylor KT, Mook DM (2009). Isoflurane Waste Anesthetic Gas Concentration Associated with the Open-Drop Method. *Journal of the American Association for Laboratory Animal Science*, **48(1)**, 61–64.
2) NIOSH Publication No. 2007- 151.
3) International Chemical Safety card (MSDS) for isoflurane.

Or refer to the specific model vaporizer user manual.

D) DEFINITIONS

1) **WAG** – Waste Anesthetic Gases = small amounts of volatile anesthetic gases that leak from the anesthetic breathing circuit or open-drop jar into the air of the procedure room during delivery of anesthesia. Animals may also exhale these gases while recovering from anesthesia.
2) **ppm** – parts per million.
3) **SDS** – Safety Data Sheets.
4) **Passive scavenging** – relies on the positive pressure from the anesthetic gas delivery system and/or the exhalation effort of the animal to drive contaminated exhaled air through a specially designed activated charcoal filter (*e.g.,* F/Air, Enviro-Pure, etc.), which will adsorb and remove the waste anesthetic agent molecules before the air is discharged back into the room.
5) **Active scavenging** - involves using low-pressure high flow ventilation to create a suction that captures contaminated air and safely discharges it from the room and the building. The simplest form of active scavenging is to deliver the anesthetic to the animal while it is placed within a properly functioning exhausted hood, downdraft table, or under a snorkel. Other systems may also be appropriate.
6) **EH&S** – Environmental Health & Safety Department
7) **LARC** – Laboratory Animal Resource Center

E) ANESTHESIA DELIVERY EQUIPMENT

1) Isoflurane vaporizer – precision delivery system designed for "out of circuit" use in continuous flow techniques of inhalation anesthesia *(Figure 1, Figure 8a)*. This is one of the preferred methods for delivering anesthetic gases.

2)

a) Gas exposure risks.

(1) Exposure to gas from an improperly closed induction chamber.

(2) Leaks from connections between various system components.

(3) Improper fit of the mask or nose cone on the animal.

(4) Not using a scavenging system.

(5) Spilling liquid anesthetic agent while filling the vaporizer reservoir or failing to adequately seal the reservoir or container afterward.

(6) Filling a vaporizer outside of the fume hood or away from the snorkel.

(7) Working in a room or area with poor ventilation.

(8) Setting the vaporizer concentration and/or oxygen levels too high.

(9) Turning on the vaporizer before attaching a breathing system to an animal.

(10) Allowing the vaporizer to remain on after an animal is disconnected from the anesthesia system.

(11) Allowing the charcoal filter to exceed its weight or time limit. Passive scavenging devices (e.g., charcoal canisters) must be labeled with the start date of use, monitored for manufacturer-recommended weight or time limits, and replaced promptly once those limits are reached. Canisters should remain upright, and the vent holes must not be obstructed. *(Figures 4,5,6,7,8b*) Used canisters must be disposed of properly in accordance with EH&S chemical waste guidelines.

(12) Excessive length of the scavenging tube from the animal to the passive or active scavenging system.

b) Practices to minimize or eliminate exposures:

(1) Utilize a scavenging system (passive or active). Active scavenging is generally superior to passive systems.

(2) Work in an exhausted hood or under a snorkel.

(3) Work in a well-ventilated area (at least 10-15 air changes per hour).

(4) Check anesthetic system connections for leaks.

(5) Ensure the mask or nose cone fits snugly on the animal.

(6) Distance yourself from the source of WAG (e.g., mask, induction chamber, animal) as much as possible to minimize exposure.

(7) Turn off the vaporizer after use.

(8) Ensure you are using proper isoflurane and oxygen level concentration.

(9) When possible, fill the vaporizer under an exhausted hood, downdraft table (exhausted out), or under a snorkel in a well-ventilated area.

(10) Flush induction chambers for 10 seconds with oxygen (with active/passive scavenging in place) without isoflurane to allow removal of lingering waste gas.

(11) Recap the isoflurane bottle and ensure the reservoir cap is adequately tightened immediately after filling the vaporizer reservoir.

(12) Check and maintain the vaporizer's calibration. This includes having the unit certified annually. Consult LARC for further information.

(13) Review the SDS for isoflurane.

3) Open-drop (jar) method under an exhausted hood, downdraft table, or snorkel, and examples of methods: The open-drop method is considered a higher-risk and non-preferred technique for the delivery of inhalant anesthesia and is permitted only under limited, well-justified circumstances when safer alternatives (e.g., precision vaporizers or Low-flow Anesthesia Systems) are not feasible.

a) If the open-drop method is proposed, this must be discussed with the Attending Veterinarian (AV) prior to approval. The AV will confirm that the proposed setup and procedures for this method will be safe and effective for the animals under the intended circumstances.

b) It is important to note that there is more risk involved with the open-drop method than with delivery via a precision vaporizer. Close monitoring of animals is paramount to avoid mortality and other complications.

c) In addition, the open-drop method is intended for use only for induction prior to transfer of the animal to a precision vaporizer-maintained system, for very short procedures that do not require re-exposure to the drop-jar prior to

completion of the procedure, or for euthanasia purposes.

d) Isoflurane is directly applied onto an absorbent material at the bottom of a jar equipped with a grate positioned above the absorbent material. Appropriate volumes of isoflurane per liter volume of the jar used and corresponding delivery percentages are noted in Table 1. The animal is then placed on the grate (located above the absorbent material to avoid direct contact of the animal with the anesthetic), and the lid is closed (*Figure 2A*). Alternatively, the anesthetic may be applied to absorbent material enclosed in a pathology cassette to avoid direct animal contact with the anesthetic (*Figure 2A*). Anesthesia gas fills the jar, and the rodent is subsequently anesthetized.

e) Isoflurane must be replenished over time to retain its potency for subsequent animals, if applicable. A general rule of thumb is to replenish after every three animals.

f) Direct application of an isoflurane dilution onto an absorbent material within a syringe casing (*Figure 3*) or centrifuge tube of appropriate size to the animal.
   (1) An animal's depth of anesthesia can be manipulated by moving the tube toward or away from the animal's nose as deemed appropriate by monitoring of physiologic parameters.

g) Exposure can occur if:
   (1) Not utilizing a scavenging system (e.g., an exhausted hood, downdraft table, or under a snorkel).
   (2) Working in an area or room with poor ventilation.
   (3) Using an incorrect isoflurane concentration.
   (4) Spilling anesthetic while filling a reservoir or applying to an absorbent material.
   (5) The jar lid is not properly closed.

h) Practices to minimize or eliminate exposure:
   (1) Only use the open-drop method in an exhausted hood, downdraft table, or under a snorkel.
   (2) Distance yourself from the source of WAG (e.g., mask, induction

chamber, animal) as much as possible to minimize exposure.

(3) Make sure the jar lid is properly closed during induction and after use.

(4) Use the correct isoflurane concentration.

(5) Apply isoflurane to absorbent material under an exhausted hood, downdraft table, or under a snorkel.

(6) Work in a well-ventilated room.

(7) Utilize an induction chamber designated for WAG scavenging (*Figure 4*)

(8) Recap the isoflurane bottle immediately after use.

(9) Review the SDS for isoflurane.

4) Low-flow Anesthesia Systems

a) Unlike traditional vaporizers, these systems are engineered with a precision syringe pump and an integrated digital vaporizer, which uses either room air or compressed gas to deliver anesthesia at low flow rates proportionate to the animal's size. (*Figure 1, Figure 8a*). This is also one of the preferred methods for delivering anesthetic gases.

b) This is an alternative anesthesia machine that has the capability of less anesthetic use, temperature monitoring & homeothermic control, SpO2, and heart rate data monitoring. This is a great system for long procedures and is available with isoflurane or sevoflurane.

c) Due to the innovative nature of the system, its use requires training prior to use.

d) Same gas exposure risks apply to the precision vaporizer (refer to section E.2.a).

e) Practices to minimize or eliminate exposures:

(1) Utilize a scavenging system (passive or active). Active scavenging is generally superior to passive systems.

(2) Work in a well-ventilated area (at least 10-15 air changes per hour).

(3) Check anesthetic system connections for leaks.

(4) Ensure the mask or nose cone fits snugly on the animal.

(5) Distance yourself from the source of WAG (e.g., mask, induction chamber, animal) as much as possible to minimize exposure.

(6) Turn off the equipment after use.

(7) When possible, fill the precision syringe pump under an exhausted hood, downdraft table (exhausted out), or under a snorkel in a well-ventilated area.

(8) Flush induction chambers for 10 seconds with oxygen (with active/passive scavenging in place) without isoflurane to allow removal of lingering waste gas.

(9) Recap the isoflurane/sevoflurane bottle and ensure the reservoir cap is adequately tightened immediately after filling the precision syringe pump.

(10) Check and maintain the equipment and calibrate if needed.

f) Review SDS for isoflurane or sevoflurane.

F) ENVIRONMENTAL AND WORK RISK ASSESSMENT

1) Personal monitoring can be conducted at the employee's breathing zone to determine WAG exposure for the employee. The monitoring is performed using a passive dosimeter, which collects gas on a media and is then analyzed by a laboratory. Occupational exposure to waste anesthetic gases should be maintained as low as reasonably achievable and should not exceed applicable NIOSH recommended exposure limits; if monitoring indicates elevated exposure levels, the use of isoflurane or sevoflurane must be paused and Environmental Health & Safety (EH&S) notified for evaluation and corrective action.

***Table 1***

| Volume of liquid agent/ 1000 ml chamber volume | Approximate concentration of isoflurane |
|---|---|
| 0.05 ml | 1% |
| 0.1 ml | 2% |
| 0.2 ml | 4% |
| 0.3 ml | 6% |

## Precision Delivery System

*Figure 1*

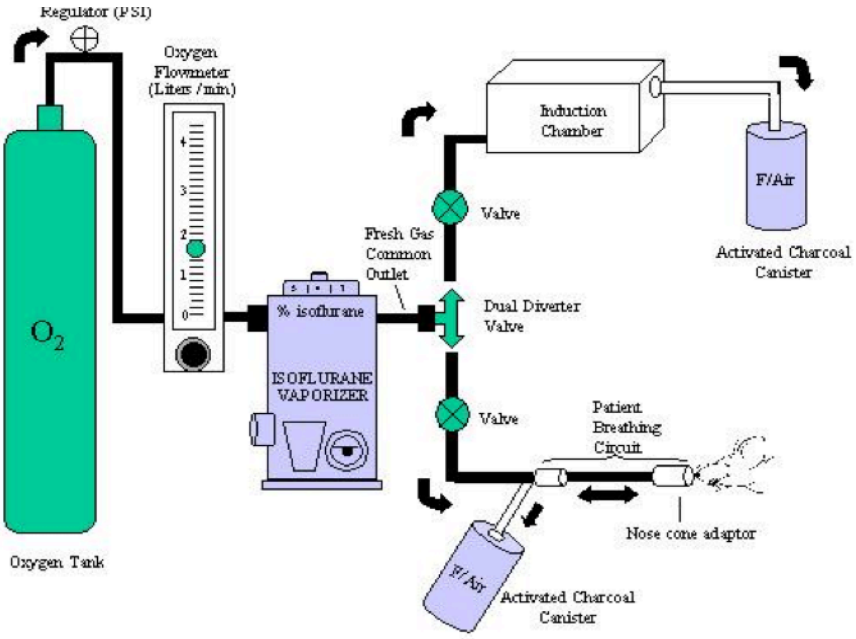
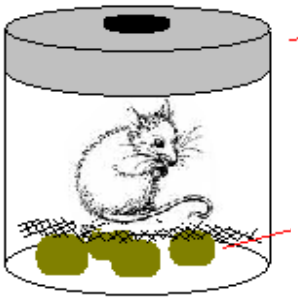



*Figure 2A*



Jar with tight fitting lid

Wire mesh separating mouse from isoflurane soaked cotton or gauze

Tissue cassette with isoflurane soaked cotton or gauze

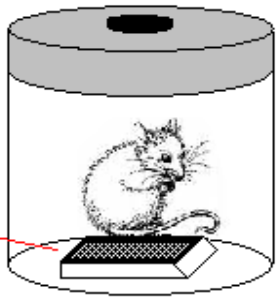
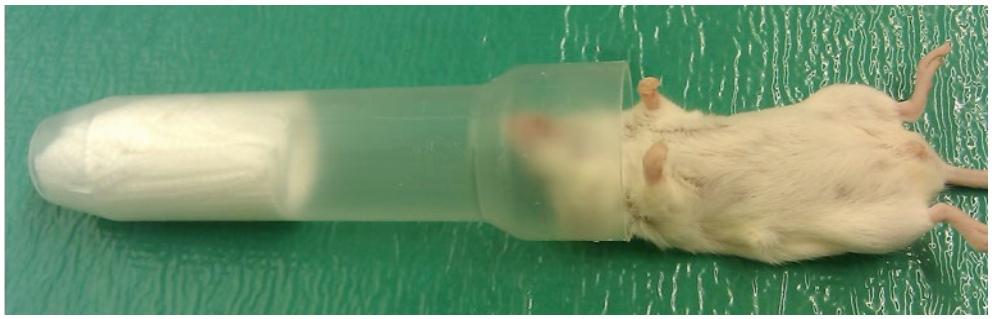


*Figure 2B*

*Figure 3*



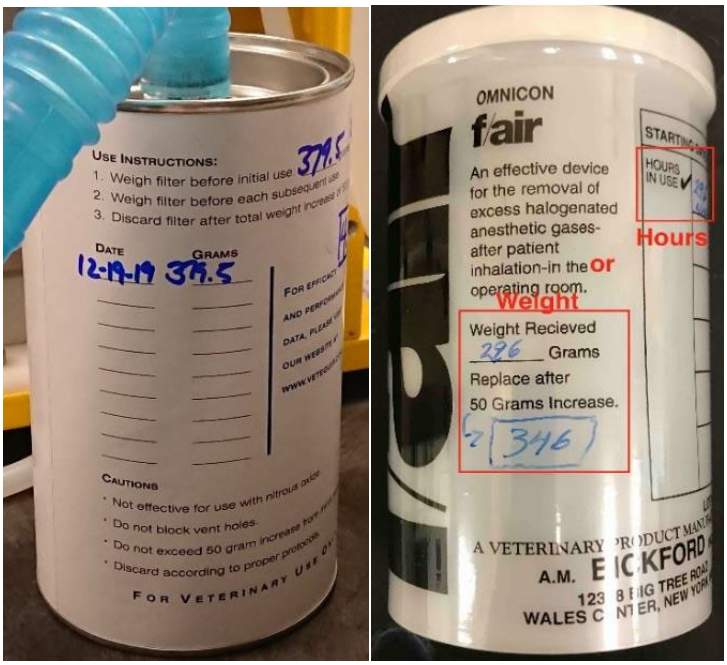



*Figure 4*


*Figure 5*

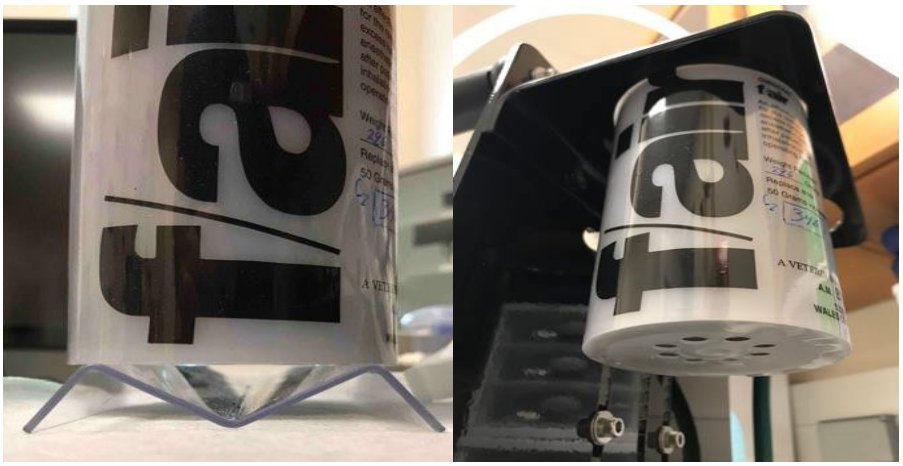
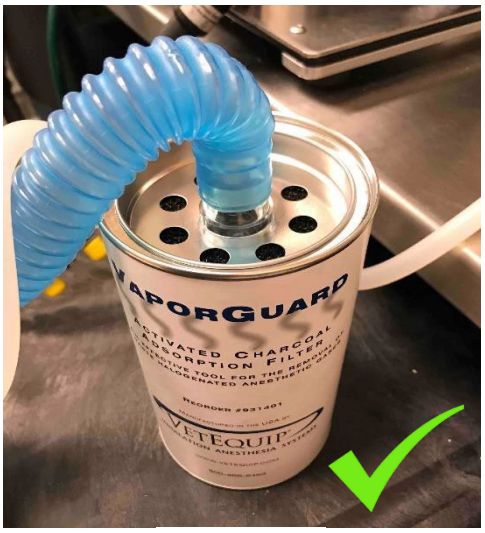



*Figure 6*

*Figure 7*



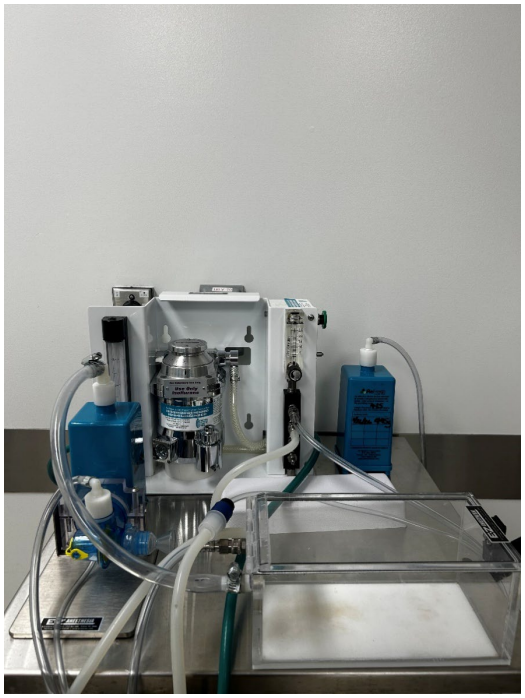



*Figure 8a*


*Figure 8b*

| Review History | |
|---|---|
| **Revision Version:** | **Revision Date**: |
| A | 14 January 2015 |
| B | 26 May 2020 |
| C | 15 December 2025 |