



SAFE USE OF ANESTHETIC GASES IN LABORATORY RESEARCH

Anesthetic gases/vapors such as nitrous oxide and isoflurane are commonly used in laboratory animal research protocols. Researcher exposure occurs primarily through inhalation of waste anesthetic gases (WAGs) unintentionally released into the laboratory environment. Possible health effects of overexposure to anesthetic gas may include, but are not limited to:

- **Acute effects:** Drowsiness, irritability, depression, headaches, dizziness, nausea, and problems with coordination, audiovisual ability, and judgment.
- **Chronic effects:** Liver and kidney disease, adverse reproductive effects and cancer.

⚠ For the hazards associated with the specific anesthetic gas you use, consult the Material Safety Data Sheet (MSDS) available from the manufacturer or at <http://msds.stanford.edu>

Integrate safety guidance from this fact sheet into:

- 1) Your laboratory's standard operating procedure (SOP) for anesthetic gas use - General information on SOP development can be found at: <http://chemtoolkit.stanford.edu/TemplateSOP>.
- 2) Your laboratory-specific safety training for proper anesthetic gas handling and use procedures.

For anesthesia-related concerns with laboratory animal care, refer to specific guidelines from SU's Administrative Panel on Laboratory Animal Care: https://labanimals.stanford.edu/policies_regulations/policies/index.html.

MINIMIZING EXPOSURE POTENTIAL - ANESTHETIC GAS CAPTURE SYSTEMS

⚠ Always work in a well-ventilated area with at least 6 room air changes per hour (ACH) regardless of gas capture/scavenging methods in use. Labs on campus are designed to have ACH rates of 6 or above. If anesthetic gases are to be used outside of a lab setting, contact the **EH&S Occupational Health & Safety Program** at **723-0448** for consultation.

1. Active Capture/Scavenging:

- **Method 1 – Fumehood/biosafety cabinet:** Work in a certified chemical fumehood or certified hard-ducted biosafety cabinet for best WAG capture performance.
- **Method 2a – Active scavenging devices (ducted):** WAG collection devices (i.e., exhausted induction chamber, snorkel trunk, surgery nose cone) are recommended to be ducted to the building exhaust system. Any building exhaust system used to prevent harmful exposure shall be tested at least annually as required by Cal/OSHA. Contact the EH&S Occupational Health and Safety Program at 723-0448 for assistance.

⚠ **Do NOT use lab vacuum as a means of active scavenging.**

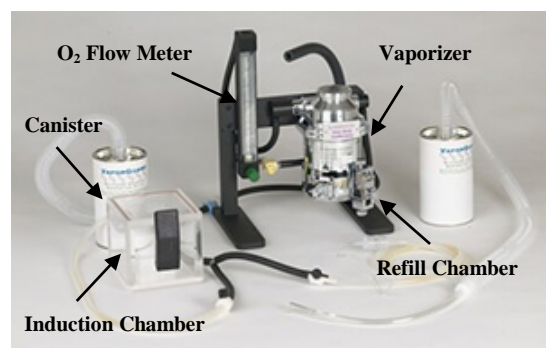
- **Method 2b – Active scavenging devices (ductless):** Where WAG collection devices (i.e., exhausted induction chamber, snorkel trunk, surgery nose cone) cannot be ducted to the building exhaust system, use an manufacturer recommended air cleaning extraction system with an activated charcoal adsorption unit to actively scavenge WAG. **NOTE: Charcoal adsorption units CANNOT be used with nitrous oxide.**

2. Passive Scavenging:

⚠ **Do NOT use passive scavenging with nitrous oxide.**

- **Method 3 – Charcoal canisters:** This method relies on positive pressure from the anesthesia machine and the anesthetized animal's exhalation to push WAGs into gas adsorption units (i.e., canisters). Any leaks in passive scavenging systems, such as from an inadequate seal on the induction chamber cover or particularly with tubing and nose cones, can cause WAG to leak into the work area.
- For small animal surgery and imaging operations, passive scavenging is not recommended.

⚠ If options for scavenging are limited, personal respiratory protection may be necessary for researcher health protection. Contact the **EH&S Occupational Health & Safety Program** at **723-0448** for consultation.



Method #3: Activated Charcoal Passive Scavenging System
(Courtesy of Visual Sonics)

MINIMIZING EXPOSURE POTENTIAL - SAFE WORK PRACTICES

1. Preparing for Anesthetic Gas Use

A. Inspect anesthesia equipment and scavenging system:

- Verify equipment used (i.e., fumehood and vaporizer) is currently certified and in proper working condition.
- Ensure vaporizer is filled with the specific anesthetic agent for which it is designed and certified. Fill vaporizer using an anti-spill bottle adaptor OR conduct filling in fumehood. When filling, wear gloves of the appropriate chemical resistance, a lab coat, and eye protection.
- Check for leaks, defects, and damage in anesthesia equipment (including hoses and valves) and scavenging system by pressure testing or by running oxygen through machine and then spraying suspected leaks with soapy water.



Example of Anti-Spill Bottle Adaptor
(Courtesy of VetEquip)

B. Prepare charcoal canisters for use:


- Charcoal canisters must be weighed before and after each use to ensure they are within manufacturer's specified limits (e.g., less than X grams above the initial weight).
- Confirm that the canister is correctly plugged into the breathing system.
- Ensure correct usage of charcoal canisters according to manufacturer's recommendations. For example, F/Air canisters should not be operated standing upright, as the exhaust port for filtered air is on the bottom, while VaporGuard canisters have exhaust ports on top.



Examples of Charcoal Canisters
(Courtesy of VetEquip)

2. Specific Safe Work Practices

A. For anesthetic inductions:

 **Open-drop anesthetic procedures are not recommended** but, if necessary, must be conducted within a fumehood or hard-ducted biosafety cabinet.

- Use the lowest concentration of anesthetic gas needed for the procedure. Contact Veterinary Service Center at 723-3876 for guidance.
- Do not turn on vaporizer until animal is in the induction chamber.
- Purge induction chamber with oxygen prior to opening chamber and retrieving anesthetized animal.

B. For surgical procedures:

- Minimize WAG leakage from animal's face mask by selecting best fitting mask. To optimize mask fit, mask diaphragms are often available from manufacturer.
- Keep WAG capture/collection devices positioned as close as possible to potential points of release (e.g. at animal face mask).
- Keep researcher's breathing zone at maximal distance away from animal face mask, as gas concentrations decrease rapidly with distance.
- If using passive scavenging systems, connect one charcoal canister to animal face mask and another to induction chamber (See Method 3 picture on previous page).

PROPER WASTE MANAGEMENT

- **Manage unused/expired anesthetic gases and liquids as hazardous waste:** Create hazardous waste tags using the Waste Tag website at <http://wastetag.stanford.edu> and attach tags to containers. Request pickup using the same website.
- **Manage spent charcoal canisters as nonhazardous waste:** Seal, bag, and label canisters as "nonhazardous waste" (include disposal date, contact name, and phone number). Request pickup of used canisters through <http://wastepickup.stanford.edu>.

ANESTHETIC EQUIPMENT MAINTENANCE

- **Establish preventive maintenance schedule:** Anesthesia machines and vaporizers are to be calibrated and certified as recommended by manufacturer (typically annually). Contact the Veterinary Service Center at 723-3876 for additional guidance.
- **Conduct inspections:** Frequently inspect condition of induction chamber seal and replace as necessary.
- **Establish written procedures:** For daily and routine inspection/maintenance of anesthesia and scavenging systems.

EMERGENCY RESPONSE

Follow emergency procedures in Stanford's Laboratory Chemical Safety Toolkit: <http://chemtoolkit.stanford.edu/emergencies>.

REFERENCES

Occupational Safety & Health Administration (OSHA), U.S. Department of Labor. *Waste Anesthetic Gases*. <http://www.osha.gov/SLTC/wasteanestheticgases/index.html>