Waste Anesthetic Gas Factsheet

Anesthetic gases/vapors such as nitrous oxide and isoflurane are commonly used in laboratory animal research protocols. Exposure may occur through inhalation of waste anesthetic gases (WAGs) unintentionally released into the laboratory environment. For the hazards associated with a specific anesthetic gas, consult the Safety Data Sheet (SDS) available from the manufacturer.

I. What are the hazards?
Possible health effects of overexposure to anesthetic gas may include, but are not limited to:

- **Acute effects:** Drowsiness, irritability, depression, headaches, dizziness, and nausea, as well as problems with coordination, audiovisual ability, and judgment.

- **Chronic effects:** Liver and kidney disease, and adverse reproductive effects.

II. How can I protect myself?

1. 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 air change rates of 6 or greater. If anesthetic gases are to be used outside of a lab setting, contact the EH&S Laboratory Safety Program at (650) 723-0448 for consultation.

   2. Engineering controls
      
      The following controls are listed in order of most effective waste gas control to less effective:
      
      a. **Active capture/scavenging**
         
         
         Method 2a – Active scavenging devices (ducted): WAG collection devices (e.g., snorkel trunk, EVAC-4, VetEquip cube) are recommended to be ducted to the building exhaust system.
         
         Contact the EH&S Laboratory Safety Program at (650) 723-0448 for assistance. **Do NOT use the house vacuum as a means of active scavenging.**
         
         Method 2b – Active scavenging devices (ductless): Where WAG collection devices (e.g., EVAC-4, VetEquip cube) cannot be ducted to the building exhaust system, use a 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.**

         - Please note that a hooded slide-top induction chamber and a compatible nosecone (e.g., CX-R or Posi-Vac) must be used with active scavenging units to minimize isoflurane exposure and ensure animal welfare.

         - Rodent anesthesia machines equipped with active waste gas scavenging devices (e.g., EVAC-4, VetEquip) can be rented through the Veterinary Service Center. The rodent anesthetic machine rental request is available [here](#).

      b. **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 an inadequate seal on the induction chamber cover, tubing, or nose cones, can cause WAG to leak into the work area. **Passive scavenging is not recommended for small animal surgery of greater than 3 hours or for stereotaxic surgery of any duration.**

         If using passive scavenging systems, connect one charcoal canister to the animal nosecone and another to the induction chamber (See Method 3 picture above).
If options for scavenging are limited, personal respiratory protection may be necessary for researcher health protection. Contact the EH&S Laboratory Safety Program at (650) 723-0448 for consultation.

3. Safe Work Practices
   a. Preparing for anesthetic gas use
      - Inspect anesthesia equipment and scavenging system.
      - Verify equipment (e.g., fume hood 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 fume hood. When filling, wear chemically-resistant gloves, 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 or Snoop.
   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., <50 grams above the initial weight); record the weight on the canister.
      - Confirm that the canister is correctly plugged into the breathing system. Use charcoal canisters according to manufacturer’s recommendations.
      - Ensure the canister holes are not obstructed. Canisters should be used upright, regardless of where gas exit holes are. For example, F/Air canister has exhaust ports at the bottom and requires a canister holder to elevate the canister above the surface of the counter, allowing gas to pass through unobstructed.
   c. Specific safe work practice for anesthetic inductions:
      For anesthetic Inductions:
      - Open-drop anesthetic procedures are not recommended but, if necessary, must be conducted within a chemical fume hood.
      - Do not turn on the vaporizer until animal is in the induction chamber.
      - Purge the induction chamber with oxygen for 5 to 15 seconds prior to opening chamber and retrieving anesthetized animal.
      - Keep the vaporizer turned off or the nosecone plugged until the animal is properly positioned in the nose cone.
      - Turn off the vaporizer or plug the nosecone before taking the animal out of the nose cone.
      - Co-administration of anesthetic and/or analgesic agents will allow lower isoflurane usage. Contact VSC at 723-3876 for guidance.
   For surgical procedures:
      Minimize WAG leakage from the nose cone by selecting the best fitting nose cone. To optimize the fit, nose cone diaphragms are often available from manufacturer. A modified diaphragm may be made from the finger of a powder-free nitrile surgical glove to increase the nose cone fitting. Modified nosecone with diaphragm is recommended for the passive scavenging system only.
      - Oxygen flow rate and anesthetic concentration should be as low as possible to minimize anesthetic gas usage. This is highly variable and dependent on strain, age, sex, analgesics used, and individual animal (e.g., 1-2% isoflurane concentration and 0.5 L/min oxygen flow rate for healthy mice/rats). Contact VSC at 723-3876 for guidance.
      - Keep WAG capture/collection devices positioned as close as possible to potential points of release (e.g., at animal nosecone).
      - Keep the researcher’s breathing zone at maximal distance away from the animal nosecone, as gas concentrations decrease rapidly with distance.
For imaging procedures:
- Close or plug the nose ports inside the imaging machine if they are not in use.

4. **Personal protective equipment**
- Standard PPE for isoflurane users are chemical-resistant gloves, lab coats, and safety glasses.
- Additional PPE may be needed depending on other chemical/physical/biological agents used in the research protocol. Please refer to the Laboratory Personal Protective Equipment (PPE) Assessment Tool to find applicable PPE.

5. **Emergency procedures**
For information on spill cleanup of spills of less than 1 ounce, see the Spill Response Standard Operating Procedure (SOP). For larger spills, call EH&S at 650-725-9999. For health emergencies, call 911 (9-911 from a campus phone).

6. **Waste management**
- Manage unused/expired anesthetic gases and liquids as hazardous waste: Create hazardous waste tags using the Waste Tag website and attach tags to containers. Request pickup using the same website.
- For empty isoflurane bottle disposal: use a non-hazardous waste tag and request pickup using the Waste Tag website.
- Manage spent charcoal canisters as non-hazardous waste: Seal, bag, and label canisters as “non-hazardous waste” (include disposal date, contact name, and phone number). Request pickup of used canisters through the Waste Pickup Request website.

7. **Equipment Maintenance**
- Establish a 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 (650) 723-3876 for additional guidance.
- Conduct inspections: Frequently inspect the condition of the induction chamber seal and the scavenging system for leaks.

8. **Safety guidance integration**
- Utilize general-use SOPs for common anesthetic waste gas scavenging methods including EVAC-4, VetEquip cube, and passive waste gas scavenging. The general-use SOPs are available here (SUNet ID login is required to access the SOPs).
  - Establish lab-specific SOPs for daily and routine inspection/maintenance of anesthesia and scavenging systems, as needed
- Integrate safety guidance from this fact sheet into:
  - Your laboratory’s SOP for anesthetic gas.
  - Your laboratory-specific safety training for proper anesthetic gas handling and procedures.

For anesthesia concerns with lab animal care, refer to guidelines from SU’s Administrative Panel on Laboratory Animal Care.

Reference
Occupational Safety & Health Administration (OSHA), U.S. Department of Labor, Waste Anesthetic Gases.