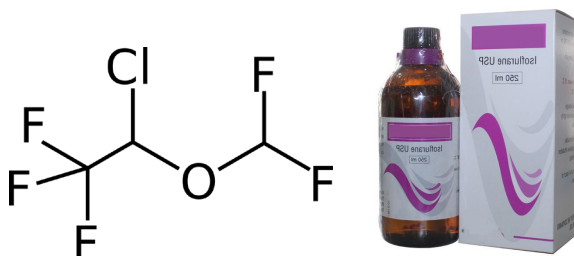




## Isoflurane Anesthetic Gas Guide



### Purpose and Applicability

Isoflurane is the most commonly used halogenated anesthetic in animal research. Exposure to second-hand anesthetic gases has been associated with several health concerns and can occur when vapors escape into the work environment during the administration of anesthesia. Since these gases are odorless and have very poor warning properties, there is no indication when an exposure to these substances is occurring.

This generic chemical safety guideline is focussed on the use of isoflurane when administered to research animals and describes basic safety practice for its handling in research labs. The principal investigator (PI) or the lab manager is responsible for developing and implementing standard operating procedures (SOPs) for the purchase, storage, and safe handling of this chemical that are specific to the PI's research.

### Hazards

Isoflurane is an eye and skin irritant and central nervous system toxicant. Long-term exposure may cause chronic or adverse health effects including nausea, dizziness, fatigue, headache, irritability, reduced mental performance, liver and kidney disease, and possible reproductive effects. Inhalation of isoflurane at high concentration levels (at or above 3%, v/v in air) may lead to death.

### Exposure Risk

The following activities have been found to have an increased risk of exposure to isoflurane:

- Not ensuring a tight seal around the animal's nose cone;
- Failing to flush the induction chamber with oxygen prior to opening the chamber to transfer animals;
- Performing multiple animal surgeries, requiring an extended length of time that anesthesia is delivered.

### Exposure Limits

The Occupational Safety and Health Administration ([OSHA](#)) has not issued a Permissible Exposure Limit (PEL) for isoflurane. However, the California Division of Occupational Safety and Health ([Cal/OSHA](#)) established PEL for isoflurane to be no greater than 2 ppm; it is the maximum level of isoflurane workers are allowed to breathe, averaged over an 8-hour day.

## Exposure Evaluation

If you have concerns about working with isoflurane or would like to have an exposure assessment performed, including sampling to determine isoflurane exposure levels, please contact EHS ([ehs@nccu.edu](mailto:ehs@nccu.edu); 919-530-7125).

## Safety Equipment

### Approved Scavenging Methods

Potential exposure routes include inhalation and skin contact. It is extremely important to control and minimize any leaks of isoflurane vapor. Waste anesthetic gas (WAG) must be scavenged through active or passive means. **Active scavenging** involves an active airflow system that draws WAG away from the researcher into an in-house WAG exhaust line, chemical fume hood, canopy hood or snorkel. **Passive scavenging** methods involves passing the WAG through an activated charcoal canister, after which it is discharged into the room.

To reduce the risk of exposure to escaped vapors, one of the following control measures should be in place when administering anesthesia:

1. Use of a downdraft surgery table or if space/procedure allows, placement of the entire gas mixing and delivery system within a fume hood (this is not appropriate for aseptic surgery procedures) or use of an in house WAG exhaust line.
2. Installation of local exhaust over the isoflurane delivery system to address a single source of anesthetic gas, or a slot or canopy exhaust for procedures that involve multiple sources of anesthetic gas (e.g., induction box, procedure table, etc.).
3. Capture of waste gas using gas scavenging canisters. The work must be done in a well-ventilated area with no recirculation of room exhaust. Scavenging canisters are appropriate under the following conditions:
  - No fume hood or other local, hazardous exhaust system is available for use;
  - Leak checks are performed routinely on equipment;
  - Saturation levels of canisters are checked prior to each use; and
  - Researchers are trained and supervised in proper use and maintenance of the anesthetic equipment.If not properly used or maintained, gases may escape into the work area resulting in overexposures.

### Equipment Calibration and Maintenance

Contact the equipment supplier or authorized technician regarding proper handling of isoflurane equipment, annual calibration and maintenance, and leak/pressure testing of an anesthetic machine. Anesthesia annual calibration for vaporizers is required unless the manufacturer states that calibration is not required (e.g., [Kent Scientific SomnoSuite](#)).

### Personal Protective Equipment

Nitrile gloves, lab coats and eye protection (safety glasses, goggles or a face-shield) should be worn to prevent contact with liquid anesthetic gases.

**Note:** N95 or R95 dust masks are not to be used as either primary or secondary respiratory protection from isoflurane exposure. If a researcher would like to use a tight-fitting elastomeric respirator, please contact EHS to evaluate the hazards through exposure assessment sampling to determine what, if any, respirator must be used, or if a voluntary respirator program is appropriate. Dust masks however may be used for protection against animal allergens.

### Spill Procedures

Purchase and maintain an isoflurane spill kit. Spill kit contents:

- 2 Absorbent pads (i.e., PIG brand absorbent pads)

- 2 Leak-proof sealable bags and container with lid
- Tongs/tweezers to pick up large pieces of broken glass
- PPE
  - Nitrile or butyl rubber gloves
  - Safety glasses/goggles
  - Tight-fitting elastomeric respirator
  - Disposable fluid-resistant apron
  - Pair of booties (optional)

### Small Spill Cleanup Procedure (<500 mL)

1. Evacuate area if possible, or at a minimum, restrict pedestrian traffic from area of spill.
2. Get the Spill Kit and don the PPE as required.
3. Bring container with spill cleanup equipment to spill area. Remove any remaining items from the container.
4. Carefully pick up large pieces of broken glass and put in the container.
5. Place absorbent pads over the spill area, start on outside of spill and work toward center. Place soaked absorbent pads into the bag (use caution if there are small pieces of broken glass present). Continue using absorbent pads as needed. Seal bag, place in container and put lid on it.
6. Rinse spill area with water and then wipe up with paper towels. If needed, mop with clean water.
7. Place contaminated disposable PPE in separate bag, place in bucket and close lid tightly. Uncontaminated disposable PPE can go in regular trash. Wipe outer lid with wet paper towel to remove any residual chemical contamination.
8. Contact EHS for [Hazardous Waste Pickup](#).
9. Complete spill report.
10. Replace spill kit contents.

During the cleanup, if you experience irritation, dizziness or drowsiness you believe may be from cleaning up the spill, leave the immediate area and notify your supervisor.

### Large Spill Cleanup Procedure (>500 mL)

Personnel discovering a spill of more than 500 mL should evacuate the immediate location if possible, keep people from entering the location, and call the appropriate emergency number(s):

- During normal work hours call EHS at 919-530-7125, after hours call University Police at 919-530-6106 or 911. When emergency responders arrive, provide factual information concerning the spill (the agent spilled, the estimated quantity, where the spill occurred, and a Safety Data Sheet).

### Exposure Procedures

**Eyes:** If anesthetic gases/liquids come into contact with eyes, immediately flush them with copious amounts of water for at least 15 minutes, using an emergency eyewash.

**Skin:** In the event of skin exposure, remove contaminated clothing and immediately wash the affected area with soap and water.

### Signs and symptoms of isoflurane exposure

Acute Exposure: nausea, vomiting, skin and respiratory irritation, including the nose and throat, headache, dizziness, and drowsiness.

Chronic Exposure: hypotension, tachycardia, respiratory depression, elevated blood glucose.

If any of these symptoms appear, seek immediate medical attention. Report exposure and/or symptoms of isoflurane exposure to PI and EHS ([Hazard and Incident Report Form](#)).

## Disposal

- Do not dispose liquid into the drain or regulated medical waste receptacles.
- To arrange for pick up and disposal of unused or expired anesthetic liquids, submit [Hazardous Waste Pickup Request](#) to EHS.
- Used charcoal canisters must be bagged and disposed of through EHS.

## Training

The PI/Lab Manager is responsible for developing SOPs specific to use of the isoflurane in their lab. Site specific and hands-on training for the use of this chemical must be provided by the PI/Lab Manager. Training should be documented in the PI's lab notebook. Review of the isoflurane safety data sheets (SDSs) must be performed before initiation of the use of this chemical.