Standard Operating Procedure
Isoflurane

Isoflurane (CAS # 26675-46-7) is a halogenated inhalation general anesthetic, commonly used in research. Isoflurane is a non-flammable, clear, colorless liquid with a mild ether-like odor. It is a very volatile liquid at room temperature and pressure.

Potential Hazards/Toxicity

Exposure to Isoflurane may cause nausea, headache, dizziness, eye/skin irritation and drowsiness. Acute effects of overexposure may cause asphyxia, respiratory depression, and coughing. The adverse behavioral effects occur at a lower concentration than any physiological damage to tissues or organs.

Exposure Limits

Although OSHA has not established a Permissible Exposure Limits (PEL) for isoflurane, the American Conference of Governmental Industrial Hygienists (ACGIH) has set an 8-hour Threshold Limit Value (TLV) for isoflurane at 50 ppm. Additionally, California-OSHA has established a 2ppm 8-hour time weighted average exposure limit.
Yale University strives to ensure that exposures are kept as low as feasible and therefore will use the Cal-OSHA 2ppm 8-hour TWA exposure limit as an initial indicator for elevated levels of isoflurane. Exposures above this level will require follow-up actions to be taken to reduce exposures. These actions include the use of engineering controls and/or work process changes. If exposures are found to be above the ACGIH TLV of 50 ppm, and levels cannot be reduced through a combination of work process changes and/or engineering controls, then the use of an air-purifying respirator will be required.

Personal Protective Equipment (PPE)

Safety glasses, nitrile gloves, and lab coat must be worn. In addition, clothing that covers the legs and solid top, closed toe shoes must also be worn whenever working in a laboratory.

Engineering Controls

Isoflurane must be used in a well-ventilated room from which there is no recirculation of exhaust air.

The following summarizes some basic methods for minimizing exposures when using isoflurane:

Drop Method/Bell Jar
- Since waste gas scavengers cannot be used with this method, it is required to be used in a fume hood, under an exhaust arm, or in a ducted biosafety cabinet.
- Use a fume hood when soaking the cotton ball with isoflurane or the isoflurane/propylene glycol solution.

Induction Chamber Use
- If possible, use in a fume hood, under an exhaust arm, or in a ducted biosafety cabinet.
- Use a gasketed chamber with exhaust port to scavenge waste gas.
- A slide-top lid is preferred over a hinged lid to prevent isoflurane gas from being pushed into the user's breathing zone.
    - If this is not possible, then facing the hinge opening of the lid away from the user is recommended.
- Once the animal is anesthetized, purge the induction chamber with oxygen for 5-10 seconds prior to opening.

Vaporizer Filling

- Fill in a fume hood, under an exhaust arm, or in an exhausting biosafety cabinet.
- Use an anti-spill adaptor that fits onto the bottle instead of pouring directly into the machine through a funnel.
- Have the vaporizer modified to use an anesthetic key filler, if possible. This will eliminate any potential exposure during the filling of the vaporizer.

Anesthesia Machine Use

- Use in a fume hood or exhausting biosafety cabinet if possible.
- Position exhaust arm at animal.
- Ensure nose cone is properly situated.

Waste Gas Scavenging

- Active Scavenging/Direct Exhaust
    - Connect vaporizer and/or induction box exhaust hose to mini vac with charcoal filter.
    - Connect vaporizer and/or induction box exhaust hose to house vacuum.
    - Route vaporizer and/or induction box exhaust hose into a chemical fume hood, exhaust arm, or ducted BSC.
- 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 carbon charcoal filter (such as F/AIR). The charcoal canister will adsorb and remove the waste gas before being discharged back into the room. Charcoal canisters have a finite effective life span, which can be monitored by weight.
    - The weight of each new canister should be recorded before its first use.
    - Before each subsequent use, the weight should be checked and recorded.
    - Canisters should be replaced when the total increase reaches the maximum weight indicated by the canister manufacturer.
    - Keep carbon canister at a level below the vaporizer in an upright position to assist passive scavenging.
    - Ensure that the holes on the bottom or top of the canister (depending on the manufacturer) are not blocked.

First Aid Procedures

If inhaled:
Remove to fresh air. Call 911 for immediate medical attention.

In case of skin or eye contact:
Rinse immediately off the skin for 15 minutes. In the case of eye contact, go to the nearest emergency eyewash and rinse for 15 minutes. Follow up with Acute Care or Employee Health.

Spills

- Do not attempt to clean-up if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operations.
- Small volumes of isoflurane evaporate readily at normal room temperatures and may dissipate before any attempts to clean up or collect the liquid are initiated.
- If a small spill occurs rapidly absorb any liquid with absorbent pads or paper towels and place in chemical fume hood for safe evaporation.
- If a large spill occurs notify others in the area and evacuate room immediately.
- Contact EHS emergency number (203-785-3555) for assistance.

Waste Disposal

Unused solutions of isoflurane will be disposed of as a hazardous material through EHS.