Safe Use of Isoflurane in Animal Care Research

Isoflurane is a halogenated hydrocarbon that is commonly used as an animal anesthetic. Exposure to halogenated anesthetic gases can result in toxicity to humans. Health effects from short-term exposure include; irritation of eyes, skin, respiratory tract; cough, sore throat, headache, drowsiness, and dizziness. The health effects from long-term exposure are not well known; specific data on isoflurane related risks to humans have not yet been produced. However, halogenated anesthetics, in general, have been linked to reproductive problems in women and developmental defects in their offspring.¹

Isoflurane is commonly used in Columbia University Medical Center laboratories that are involved in animal research. As part of the Environmental Health & Safety (EH&S) risk assessment strategy to evaluate potential personnel exposure to regulated chemical substances, EH&S conducted assessments to evaluate the ambient waste anesthetic gas concentrations that personnel may be exposed to during animal procedures. The monitoring took place during procedures in which mice were sedated by placement in an induction box connected to an isoflurane vaporizer, the mice were subsequently transferred to a work station where nose cones are used to continually supply isoflurane.

The National Institute for Occupational Safety and Health (NIOSH) recommends that personnel should not be exposed to halogenated anesthetic gas concentrations in excess of **2 parts per million (ppm)** on average for any period longer than one hour². The results of the assessments conducted by EH&S indicated that the level of personnel exposure to isoflurane vapor may exceed the NIOSH Recommended Exposure Limit (REL) when proper controls to prevent inhalation of waste anesthetic vapors are not used. Exposure due to inhalation may occur mainly due to waste anesthetic gas escaping from the induction box in which rodents are sedated and also due to release of unscavenged isoflurane gas escaping from nose cones where the rodents are placed during procedures. It is strongly advised that appropriate engineering controls, such as those recommended below, are used to minimize personnel exposures to isoflurane vapor during small animal procedures.

Examples of **Improper or Inadequate** Engineering Controls for Prevention of Waste Anesthetic Gas Exposure:

Below are examples of conditions under which exposure to waste isoflurane vapor in concentrations above the NIOSH recommended exposure limit (REL) is likely to occur:

**Image 1.** An induction box placed in a HEPA filtered Biological Safety Cabinet. Waste isoflurane is simply recirculated in the room; as HEPA filters do not scavenge or adsorb chemical vapors.

**Image 2 (left)** An induction box connected to an activated charcoal canister. Although some waste isoflurane vapor may be scavenged due to passive diffusion into the canister and adsorption by the activated charcoal, it has been observed during EHS assessments that in the absence of an active scavenging system significant exposure may still occur. **Image 3 (right)** A makeshift induction chamber with no controls in place to prevent user exposure.
Examples of **Proper** Engineering Controls for Minimizing Waste Isoflurane Exposure:

Using a vapor extraction system when using the isoflurane vaporizing equipment will prevent personnel from inhaling waste isoflurane vapors. If a ducted certified chemical fume hood is not available, it is recommended to utilize an appropriately exhausted negative pressure system. A snorkel hood could also be installed above the vaporizer apparatus.

![Image 4. Snorkel Hood connected to building exhaust system, used for controlling and exhausting waste vapors during animal procedures.](image)

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![Image 5 (left) A Certified Chemical Fume Hood would be the most appropriate control for controlling waste anesthetic gas. Image 6 (center) Laminar Flow Hood (Negative Pressure hood) with activated carbon filtered exhaust chamber. Image 7 (right) The Scavenging cube creates low-pressure/high-flow exhaust in the induction chamber.](image)

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Isoflurane Exposure Measurements: Controlled vs. Uncontrolled Systems

Exposure monitoring of personnel using improper or inappropriate engineering controls to prevent inhalation of waste isoflurane vapors indicated that overexposure above the REL of 2.0 ppm is likely to occur.

Monitoring of personnel using proper engineering controls to prevent inhalation of waste isoflurane vapors indicated that exposure was measured to be well below the REL of 2.0 ppm.
Environmental Health & Safety Laboratory Exposure Assessments:

Upon request the office of Environmental Health and Safety is available to perform assessments of your vaporizing apparatus. EHS is available to monitor personnel exposures during animal procedures and provide recommendations for reducing personnel exposure and instituting proper controls. If you would like to request an assessment in your laboratory, please use the following link, complete the attached form. EHS will review the information provided and contact you to setup an appointment.

http://ehs.columbia.edu/LaboratoryHazardAssessmentForm.pdf

For any questions or comments regarding the above information, please contact EHS at (212) 305-6780.