

Isoflurane



Stephen Pickup
Technical Director of SAIF
(215) 746-1423
pickup@pennmedicine.upenn.edu

Isoflurane Exposure: Health Effects

- Safety of SAIF users and staff is a high priority. SAIF and EHRS are working together to minimize ISO exposure in SAIF labs.
- Adverse health effects due to multiple acute ISO exposure: Literature review
 - Neurotoxicity in the developing brain (in-utero to adolescence) leading to cognitive deficits.
 - Liver necrosis and apoptosis are significantly increased following exposure.
- Adverse health effects due to chronic low level ISO exposure: Literature review
 - ???

Environmental Health & Radiation Safety (EHRS) : Isoflurane Exposure

- Controlling Exposure to Animal Inhalation Anesthetics
 - <https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets/fact-sheet-exposure-animal>
- Health Effects: high concentrations may cause headache, irritability, fatigue, nausea, drowsiness, impaired coordination, liver and kidney damage. Long term low level exposure has been linked to miscarriages, genetic damage and cancer.
- The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit is 2 ppm for a period not exceeding one hour.
- It is the goal of SAIF and EHRS to maintain ISO exposure below the NIOSH recommended limit.
- Regular leak testing of anesthesia equipment will play a critical role in achieving this goal.



NEVER MODIFY SAIF ANESTHESIA EQUIPMENT

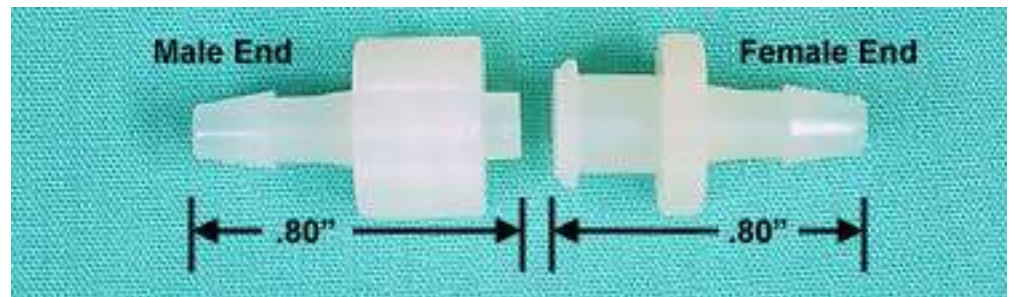
- Lab safety is a collaboration between users and SAIF staff.
 - SAIF will provide equipment and training.
 - Users adhere to SOPs and notify SAIF of any deficiencies.
- SAIF staff is reconfiguring our anesthesia rigs to be air tight.
- Only use the fittings provided by SAIF.
 - Lure Lock for nose cones
 - Anesthesia fittings elsewhere
- TAPE IS NOT A FITTING!!!!
- If you find that a rig is not properly configured, notify SAIF staff and it will be repaired.
- If you need to connect non-SAIF equipment to our anesthesia rig, contact SAIF staff and we will provide the necessary fitting.

Anesthesia Fittings

- Nose cones : barb to Lure Lock, flow is always out of the male and into the female.



Flow Direction



- Vaporizer to Induction Box :22 mm x ¼" tubing to tapered anesthesia fitting
- Induction box to corrugated anesthesia tubing : 22 mm Tapered anesthesia fitting. Often built into the box.

Know Your Anesthesia System

- Several different anesthesia configurations are used. The SOPs for minimization of ISO exposure vary between systems.
- Stem in fill tank (Type 1 & Type 2) is the valve for draining the tank. If leaking, tighten the stem, do not plug drain port.
- Purge button (Type 2) bypasses the vaporizer and is used to purge induction box.

Type 1



Type 2



Type 3



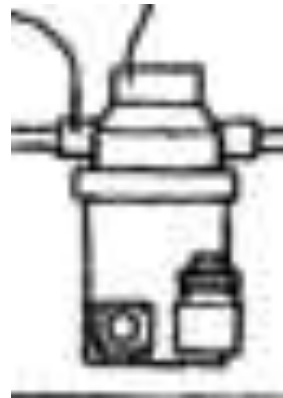
Induction Box

- Induction box is the largest source for ISO exposure.
- Sliding door boxes leak (never stand F/Air canister on end).
- Box with gasket seals when gasket is good. Gaskets flatten out with use. Gaskets need to be replaced periodically.
- Always purge induction box for approximately 10 sec before opening.



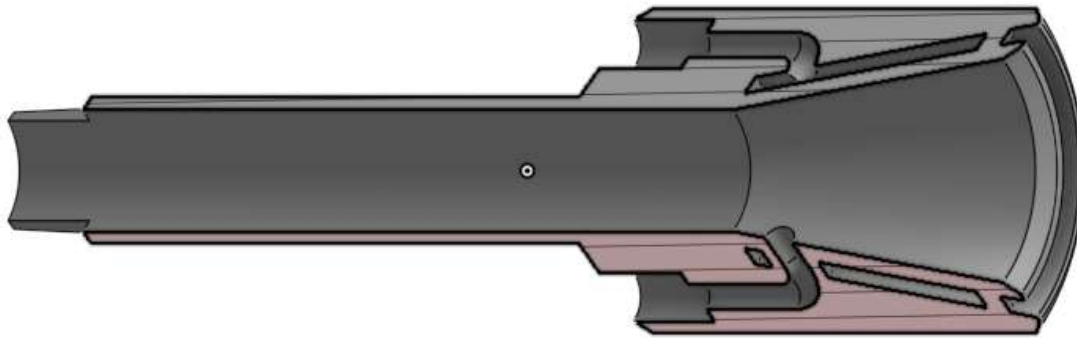
Active Scavenging: Waste anesthesia gas disposal (WAGD)

- WAGD has been shown to be highly effective at minimizing ISO exposure when used correctly.
- Should be used whenever available (Smilow).
- Use WAGD compatible nose cone whenever possible.
- Use WAGD to purge induction box before opening.



3D Printed Nose Cones: Evacuation around outer edge of nose cone.

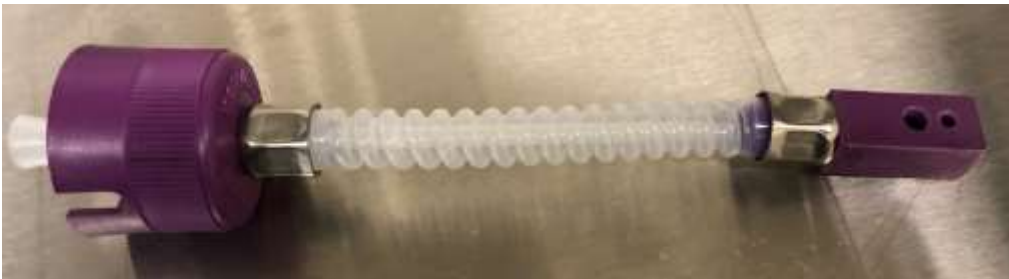
- Mouse WAGD compatible nose cone



- Design is effective when WAGD is available (Smilow), freely distributable and inexpensive to produce.
- Bite bar can be used to secure the position of the nose cone and animal.
- 3D printed materials are very permeable and need to be sealed before use.
- Nut and bite bar can not be 3D printed and as such could be expensive to produce.

Preparation to use Isoflurane Anesthesia

- Inspect anesthesia apparatus. Make sure the system is properly configured and all fittings and gaskets are present and in good working order.
- Record weight of F/Air canisters in the in the apparatus being used. If weight is more than 50 g over original weight, replace canister.
- Prepare device to warm animal while under. Give device time to stabilize if needed.
 - Water circulating pad, heat lamp, heated table
 - In some cases the heating device is built into the imaging modality
- Check the Isoflurane level in the vaporizer and fill if necessary.



Small Animal General Anesthesia

- Open valve between induction box. Make sure that all other valves are closed.
- Turn on gas flow, 0.5 – 1.0 lpm
- Set ISO level to 3%
- When animal is sedated, turn off ISO (0 %) and purge induction box for approximately 10 sec
 - When available open valve between induction box and WAGD
 - Press purge button on vaporizer.
- Open valve between vaporizer and nose cone, close valve between induction box and nose cone,
- Open valve between WAGD and nose cone, set ISO level to 1-3%
- Open induction box and mount animal in nose cone.
- When procedure is finished, turn off ISO, turn off gas, remove animal from nose cone and observe until fully recovered

ISO Exposure Minimization: Current Status

- SAIF has just started the process of assessing it's anesthesia systems and addressing issues.
- In the process of purchasing an ISO detector.
- Purchased a supply of fittings, tubing and other supplies
- To date we have only one WAGD regulator, others will be purchased soon.
- Each anesthesia system will need to be assessed and serviced independently.
- Detailed SOPs will be developed and provided to users for each system.
- Exposure issues for each system will need to be reassessed on a regular basis.
- Users be patient and work with SAIF staff.

DO NOT MODIFY SAIF ANESTHESIA EQUIPMENT

- If something is missing, broken or leaking, contact SAIF staff and they will service the system.