

# **INDUSTRIAL HYGIENE REPORT**

## **Control of Isoflurane Vapor**

### **In the Workplace**

**November 2010**

**For:** Sentry Air Systems, Inc.  
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## Control of Isoflurane Vapor in the Workplace

**Introduction:** Isoflurane is an anesthetic agent used primarily in hospitals and veterinary settings to anesthetize animals and humans preparatory to surgery or other medical purposes. Isoflurane is a halogenated ether and is a volatile, non-flammable liquid (b.p. 48.5° C or 119.3 ° F). Its chemical name is (2-chloro-2-(difluoromethoxy)-1,1,1,-trifluoro ethane. It is relatively non-toxic and is always used together with air or oxygen, and sometimes with nitrous oxide gas. There is no established PEL (Permissible Exposure Limit) or TLV (Threshold Limit Value), but an 8-hr. TWA (time-weighted average) exposure limit of 60 ppm has been set by one manufacturer<sup>1</sup>. Purchase of Isoflurane normally requires a doctor's prescription.

**Purpose:** The purpose of this project was to demonstrate the effectiveness of the *Winged Sentry™* (Model SS 300 WSL) in collecting and removing Isoflurane vapor produced by the evaporation of a measured amount of liquid Isoflurane. The *Winged Sentry™* was equipped with a HEPA filter and an activated charcoal filter. Note that only the charcoal is active in capturing Isoflurane vapors. Two models of the *Winged Sentry* are available (Model SS-200-WSL and Model SS-300-WSL).

**Discussion:** Isoflurane is typically used for anesthesia purposes in a hospital room using a "vaporizer", a machine which produces a precisely controlled mixture of Isoflurane vapor and air, oxygen and/or nitrous oxide and delivers it to the patient. Some Isoflurane may escape into the room air and can be a health concern for operating room personnel, since Isoflurane has poor warning properties and air concentrations could reach several times the recommended limit before being detected by odor. The *Winged Sentry™* can be used to adsorb Isoflurane near the point of use, or for general room air purification. For purposes of this experiment a measured amount of liquid Isoflurane was distributed drop-wise from a burette onto several cotton balls placed in a shallow pan. The cotton provided a large surface area to facilitate the evaporation of the Isoflurane. When the *Winged Sentry™* was turned on, a stream of air was drawn across the cotton balls and into the Sentry machine.

<sup>1</sup>Hospira, Inc., 275 North Field Dr., Lake Forest, IL 60045.

**Experimental:** The air flow rate of the *Winged Sentry™* was set at approximately 240 cfm (cubic feet per minute) and 40.4 ml (60.4 grams) of Isoflurane was dispensed from a 50-ml burette and evaporated into the air stream over a 30-minute period. Air samples were obtained during the experiment using SKC 226-81A sorbent tubes and battery-powered sampling pumps (OSHA Method 103). The pumps were set to pull about 500 cc/min. and were pre- and post-calibrated. All personnel involved in the sampling project wore half-face, air-purifying respirators equipped with an organic vapor cartridge when Isoflurane was being handled. The operator also wore eye protection. Samples were taken at the inlet to the *Winged Sentry™* machine, at the outlet of the *Winged Sentry™* machine, and in the breathing zone of the Operator. The samples, including a blank, were sent to an AIHA-certified laboratory for analysis using gas chromatography (GC-FID).

**Results:** The sampling results are presented in the following tables.

**Table I**

**Analysis of Samples collected for Isoflurane while using the *Winged Sentry™***

**Inlet vs. Outlet**

<b>Sample #</b>	<b>Sample Description</b>	<b>Avg. Flow Rate, cc/min</b>	<b>Sampling time, min.</b>	<b>Sample vol., liters.</b>	<b>Isoflurane found, mg (ppm)</b>	<b>% Removal</b>
<b>RFA-001</b>	<b><i>Winged Sentry™</i> Inlet</b>	<b>524.5</b>	<b>30</b>	<b>15.735</b>	<b>42 (350)</b>	<b>-----</b>
<b>RFA-002</b>	<b><i>Winged Sentry™</i> Outlet</b>	<b>535.0</b>	<b>30</b>	<b>16.050</b>	<b>0.022 (0.18)</b>	<b>99.95</b>

**Table 2**

**Analysis of Personal Sample for Isoflurane while using the *Winged Sentry™***

<b>Sample #</b>	<b>Sample Description</b>	<b>Isoflurane found, mg</b>	<b>Isoflurane found, ppm</b>	<b>Recommended Standard, ppm</b>
<b>RFA-003</b>	<b>Operator (McKay Hansen)</b>	<b>0.27</b>	<b>2.4*</b>	<b>60 (8-Hr. TWA)</b>
<b>RFA-004</b>	<b>Blank</b>	<b>&lt;0.003</b>	<b>-----</b>	<b>-----</b>

\*The recommended exposure limit (8-hr TWA) is 60 ppm; there is no STEL (short term exposure limit), nor are there any OSHA limits for Isoflurane.

**Results and Conclusions:**

1. The Sentry Air Systems *Winged Sentry™* unit did an excellent job of removing Isoflurane from the air in the experiment described herein. The calculated efficiency of removal was 99.95% by weight.
2. The Operator was provided with excellent protection throughout the experiment. His potential exposure, without regard to his use of a respirator, was only 2.4 ppm for 30 minutes. Assuming no further exposure during the day, his 8-hr. TWA would have been 0.15 ppm, versus a recommended exposure limit of 60 ppm.
3. The *Winged Sentry™* is recommended for use in operating rooms, laboratories and other workplaces for the control of Isoflurane vapor.

If you have any questions or comments regarding this report, please contact me at 713-983-7910 or by e-mail at BobCIH@aol.com.

Respectfully submitted,

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**NOTE: The MSDS (Material Safety Data Sheet) for Isoflurane used in this project can be found at:  
<http://www.medicalpurchasingsolutions.com/specials/Isoflurane250mlMSDS.pdf>**