

**VA NORTHEAST OHIO HEALTHCARE SYSTEM
Louis Stokes Cleveland DVAMC
Medical Research Service
Subcommittee on Research Safety Policy**

Effective Date: AUGUST 10, 2022

Policy Title: WORK INVOLVING HAZARDOUS VAPOR FORMING CHEMICALS IN RESEARCH

Policy Number: SRS--017

Policy Version: .02

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1. PURPOSE:

This policy promotes the prevention of exposure to vapor forming chemicals, which will follow guidance set-forth by the Occupational Safety and Health Administration (OSHA): 29 CFR § 1910.1000 – Air contaminants, Toxic and Hazardous Substances.

In regard to halogenated anesthetics, which includes Isoflurane, The National Institute for Occupational Safety and Health (NIOSH), recommends that no worker be exposed to greater than two parts per million (ppm); See Chemical Hygiene Policy 005 WASTE ANESTHETIC GASES AND VAPORS.

Hazard Communication Standard (HCS) establishes the employee's Right to Know regarding safety and health information, chemicals that they are working with, and chemicals that are in the facility. HCS is designed to protect against chemical-source illnesses and injuries by ensuring that employers and employees have knowledge of protective measures and employ engineering controls.

Monitoring personnel that work with vapor forming chemicals ensures that these measures are effective. This is based on the existence of exposure limits, the likelihood of exposure, and established regulations, i.e. 29 CFR § 1910.1000, and chemical specific standards, e.g. 29 CFR § 1910.1048, Formaldehyde. This information, in conjunction with an exposure assessment (conducted by the Facility Safety Office) is what determines the need to monitor exposure to chemicals. The Facility Safety Office also monitors exposure to particulates and gases in addition to chemical vapors.

29 CFR § 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories also applies. In addition, this Medical Center is obligated to provide a workplace free of recognized hazards per the General Duty Clause Section 5(a)(1) of the Occupational Safety and Health Act

2. DEFINITIONS:

- a. OSHA – Occupational Safety and Health Administration
- b. HCS – Hazard Communication Standard
- c. RSC – Research Safety Coordinator

- d. Vapor Forming Chemical Monitors – Monitors that measure toxic vapors regulated by OSHA.
- e. SDS – Safety Data Sheet
- f. GHS – Global Harmonization System
- g. PPE – Personal Protective Equipment
- h. ARF – Animal Research Facility
- i. WAGD – Waste Anesthetic Gas Disposal
- j. PEL – Permissible Exposure Limit
- k. STEL – Short-term Exposure Limit
- l. ppm – Parts Per Million
- m. NIOSH – National Institute for Occupational Safety and Health
- n. ACGIH® – American Conference of Governmental Industrial Hygienists

3. **RESPONSIBILITY:**

- a. Research personnel are responsible for compliance with this policy.
- b. Principal Investigators and Laboratory Directors/Supervisors will ensure that personnel follow this policy.
- c. The Research Safety Coordinator (RSC) will work with Principal Investigators, Laboratory Directors/Supervisors, Engineering Services, and the Facility Safety Office to ensure compliance with this policy.
- d. Engineering Services will maintain facility-related engineering controls that prevent exposure to vapor forming chemicals, i.e. Fume Hoods, hospital vacuum system, ventilation, electrical systems, etc., with the submission of a Service Request in the Medical Center's IBM® Enterprise Asset Management System: Maximo®.
- e. The Facility Safety Office will annually measure the face velocity of each Fume Hood within Medical Research Service.

The Facility Safety Office will provide the RSC with monitors that measure an employee's exposure to vapor forming chemicals (See OSHA Annotated Table Z-1 in Section 5, Procedures, part e, Exposure Monitoring, subpart II, below). Facility Safety Office will establish baseline monitoring and determine frequency of monitoring based on results.

- f. Research will initiate all respirator use through the Facility Safety Office. Personnel Health will provide medical clearance for Research personnel using respiratory protection.

4. **POLICY:**

To ensure compliance as described in Section 5, PROCEDURES, below.

5. **PROCEDURES:**

a. Knowledge of Protective Measures – This is obtained through the Chemical Hygiene Plan, Safety Data Sheets (SDSs), labels, employee training, and the knowledge of appropriate Standard Operating Procedures (i.e. laboratory and Animal Research Facility, e.g. Waste Anesthetic Gas [Isoflurane]).

- I. Safety Data Sheets – Safety data sheets (SDSs) are standardized documents that contain occupational safety and health data. Section 8, Exposure Controls/Personal Protection, provide guidance for work involving vapor forming chemicals. The facility uses MAXCOM chemical management system to maintain chemical inventories for all locations.
- II. Labels – Chemical containers have a precautionary statement, which is a phrase that describes recommended measures to minimize or prevent adverse effects resulting from exposure, which may include Personal Protective Equipment (PPE).
- III. Employee Training – Employees receive the following training:
 - A. New Employee Safety Orientation and Annual Research Safety Training thereafter. This training includes general guidance that instructs Research personnel to utilize PPE to prevent exposure to vapor forming chemicals.
 - B. Hands-On Training. This training includes specific guidance that instructs Research personnel how to utilize Personal Protective Equipment (PPE) to prevent exposure to vapor forming chemicals.
 - C. Web-Based Training. The Collaborative Institutional Training Initiative (CITI) Program – a leading provider of research education content, offers a locally written course in Waste Anesthetic Gas Safety Policy.
 - D. Standard Operating Procedures. Written procedures that relate to the equipment and/or chemicals used by research personnel working with vapor forming chemicals. Procedures are a series of actions that reduce potential exposure. These procedures are specific to an employee's work site, which may be located in a Standard Operating Procedure, manual, etc. This document gives an employee a step-by-step guideline to perform a procedure in a manner that prevents exposure to themselves and/or co-workers from vapor forming chemicals (see part d, Administrative Controls, below).

b. Employ Engineering Controls – Engineering controls remove the hazard at the source before it comes into contact with the employee, which involve protective equipment, procedures, and facility-related systems that reduce the risk of worker exposure to vapor forming chemicals.

- I. Fume Hoods – Fume hoods are critical to the removal of chemical fumes and toxic gases away from Research personnel. A Fume Hood is an enclosed/ventilated space used in a laboratory to contain and exhaust vapor forming chemicals and other inhalational hazards. The OSHA Laboratory Standard states that a Fume Hood face velocity should typically be 60-100 linear feet per minute. A Kimwipe® is affixed to the sash of each fume hood; this provides a visual indication that the fume hood has “pull”.
- II. Class II Type B2 Biosafety Cabinets – Class II Type B2 Biosafety Cabinets protect users from hazardous agents (non-volatile and volatile toxic chemicals and radionuclides), including vapor forming chemicals, that require hard ducting to the outside
- III. Downdraft Table – Downdraft tables are workbenches with built-in ventilation to capture dust, smoke, and fumes. They are constructed with a perforated surface; the underside is connected to a ventilation collection system, which draws hazardous materials, including vapor forming chemicals, through the holes and away from the employee. Note: It is less effective than a fume hood or vented Biosafety Cabinet for containment of hazardous vapors.
- IV. Waste Anesthetic Gas (WAGD) Scavenging Systems – A Waste Anesthetic Gas Disposal System removes vented anesthetic gases away from Research personnel performing animal surgery. Exposure to anesthesia (specifically Isoflurane) is decreased by this scavenging method. A high-pressure leak test of the anesthetic equipment components is performed every four months. All personnel working with anesthetic equipment are to be familiar with Animal Research Facility SOPs specific for work involving Isoflurane.

Note: The use of Nitrous Oxide (N₂O) is prohibited from being used.

c. Personal Protective Equipment (PPE) specifically involves the use of respirators. Respirators are designed to protect the respiratory systems of Research personnel by filtering out vapor forming chemicals. Specific respirator cartridges are required for particular substance to be handled, i.e. Organic Vapor, Ammonia, Methylamine, Formaldehyde and Acid Gas (Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Sulfide, Hydrogen Fluoride, Chlorine Dioxide), etc. Prior to wearing any respirator:

- I. Personnel Health Service must determine if an employee has any medical limitations due to medical or workplace conditions prior to wearing an air filtering respirator.
- II. The Facility Safety Office must perform a fit test in accordance with the Medical Center’s Respirator Training and manufacturer’s recommendations and Medical Center Policy 138-033 Respiratory Protection.

d. Procedures are a series of actions that reduce potential exposure. These procedures are specific to an employee’s work site, which may be located in a Standard Operating Procedure, manual, etc. This document gives an employee a step-by-step guideline to perform a procedure in a manner that prevents exposure to themselves and/or co-workers from vapor forming chemicals.

e. Facility-related systems aid in the prevention of exposure. Facility-related systems include room ventilation, electrical service, and the hospital vacuum system.

- I. Regularly scheduled preventive maintenance of ventilation systems are performed to ensure maximum effectiveness. There a minimum required air exchange rate for rooms where hazardous volatile chemicals will be used (i.e., 10 - 15 air changes/hour). This shall be verified at least quarterly by airflow measurements by the Facility Manager, Engineering Service. In the event that there is an interruption in air exchanges, the RSC will notify Research personnel.
- II. The Electric Shop, Engineering Services, conducts monthly generator testing and power outage drills to ensure that Emergency Back-up Power functions.
- III. The hospital vacuum system is maintained by the Plumbing Shop, Engineering Services.

Note: In the event that a ventilation, electrical, and/or vacuum system failure occurs, the planned procedure must be cancelled until the affected systems are deemed “in working condition” by the Medical Center’s Engineering Service. When notified of an engineering-related outage, the RSC will submit a Service Request to have service restored.

f. Administrative Controls – Administrative controls include training, procedures, and policies that lessen the threat of a hazard to an individual.

- I. Employee training for work involving vapor forming chemicals is defined above.
- II. Laboratory and surgical procedures (provided by Principal Investigators and/or Lab Directors/Supervisors) require a written plan, i.e. Standard Operating Procedure, for work involving the use of vapor forming chemicals. This written procedure provides guidance to the laboratory and/or surgical technician on the safe use and operation of engineering controls, PPE and the needed safety measures when using a particular vapor forming chemical. This written plan needs to be reviewed at the start of employment, to ensure compliance, and to re-train personnel when an over exposure occurs.
- III. SRS Policy 017 - Work Involving Vapor Forming Chemicals in Research provides a written overview for work involving vapor forming chemicals to ensure safe work conditions are being met.

g. Exposure Monitoring – Exposure monitoring is a method of measuring the airborne concentration of a chemical of interest using the limits set by OSHA and recommendations by NIOSH and ACGIH® – American Conference of Governmental Industrial Hygienists.

Each chemical is monitored in a unique way. Most vapor forming chemicals used in Research can be monitored by passive dosimeter badges. Gases, particulates, and some unique vapor forming chemicals would be measured using other methods. Monitoring measures concentrations that can be compared to related exposure limit is such as time-weighted average exposure, short term exposure, and ceiling limits. Monitoring will be conducted to establish baseline levels, and a monitoring frequency will then be established from this data. The Facility Safety Office must be notified of

changes in procedures or control measures as baseline monitoring will need to be re-established. OSHA sets these limits; NIOSH and ACGIH make recommendations for PEL, STEL, and ceiling limits, which are accepted and endorsed by the VA.

Personal and Area exposure monitoring are most frequently conducted using dosimeters for vapor monitoring. Dosimeters for personal exposure monitoring must be within the breathing zone to be effective; they need to be clipped onto to the employee's lab coat, scrub shirt, surgical gown, etc. near the collar bone. Area dosimeters measure the vapors within the work site and need to be placed at a work surface height at approximately six feet from the location in which work involving a vapor-forming chemical is being used.

See Medical Center Policy OOS-026, Waste Anesthetic Gases and Vapors.

The Facility Safety Office forwards measurement readings to the Chief/Engineering Services, the Associate Chief of Staff/Research, the RSC, and Personnel Health. Personal and area monitoring of vapor forming chemicals includes initial "baseline" monitoring and periodic monitoring thereafter.

- I. Exposure Limits: The recommended limits, which are recognized by Occupational Safety and Health Administration (OSHA), have Ceiling Limits. Ceiling Limits are the upper boundaries of harmful substances to which a person should not be exposed to and shall at no time exceed the exposure limit given for that substance, e.g., if the PEL for a vapor forming chemical is 2.0 parts per million (ppm), the ceiling is 2.0 ppm; over exposure for that substance will be 2.0, as cited in 29 CFR § 1910.1000 – Air contaminants.
- II. Short-term Exposure Limit (STEL) is the maximum concentration of a chemical to which workers may be exposed continuously for a short period of time without any danger to health, safety or work efficiency. Permissible Exposure Limits are listed in OSHA Annotated Table Z-1

<https://www.osha.gov/dsg/annotated-pels/tablez-1.html>

On the OSHA website, it is noted that, "This table only includes occupational exposure limits (OELs) for substances listed in the OSHA Z-1 Table. OELs for hundreds of additional substances [including isoflurane] have been adopted by Cal/OSHA, NIOSH, and ACGIH. These organizations periodically make revisions to their OELs and so they should be consulted directly for their most current values and substances, as well as special notations such as for skin absorption." These guidelines are referenced by the Facility Safety Office when passive dosimeter badge measurements are received.

- III. Action Level – This Medical Center defines an action level as one half of the permissible exposure limit (PEL), unless otherwise established in regulation. For example, if the PEL for a vapor forming chemical is 2.0 parts per million (ppm), the action level is between 1.0 - 1.99 ppm. The intent is to initiate measures to eliminate or reduce employee exposure before reaching the established exposure limits. After an assessment of these guidelines, baseline monitoring of the original monitored procedure will be conducted.

h. Over Exposure – Over exposure is a measurement at/or above the ceiling level. When an over exposure to a vapor forming chemical occurs, the employee’s knowledge of protective measures, a review of the written procedures and how they are to be followed, the use of Personal Protective Equipment, and the functionality of engineering controls will be assessed. Additional measures may be established to ensure exposures are reduced. After an assessment of the employee’s knowledge, procedures, and the assurance that engineering controls are properly functioning, and implementation of additional measures to eliminate or reduce exposure, baseline monitoring of the procedure will be conducted.

When an over exposure has been confirmed by the Facility Safety Office, the employee(s) involved should report to Personnel Health Service. At that point, an employee has the option to decline treatment/to be seen by a Personnel Health Service physician, or, accept treatment for an over exposure. This must be repeated for every measured over exposure.

When an over exposure occurs, a Spill/Incident Report must be completed. The completed/signed report will then be placed on a Subcommittee on Research Safety and Security (SRS) agenda for review. At that time, the SRS will determine if the event reviewed requires reporting to the Office of Research Over-site.

The employee’s technique will be observed by the PI, Lab Director/Vet. Tech., and/or Supervisor, in order to potentially identify lapses in technique that could exacerbate an over-exposure. When an employee is re-monitored, and an over exposure is measured for the second time, the above noted actions will be repeated.

Vapor Forming Chemicals (excluding Isoflurane):

In the event that engineering controls are functioning properly (as confirmed by Engineering Services or an outside company) and written procedures have not changed (as per the Principal Investigator/Supervisor) and the measured over exposures are due to an employee’s lack of knowledge and/or continued procedural errors, these repeated over exposures will be addressed by the Subcommittee on Research Safety (SRS). Until an SRS determination is made, the employee(s) will not be permitted to work with the substance that measured over the PEL.

Isoflurane:

In the event that engineering controls for scavenging Isoflurane are functioning properly (as confirmed by Engineering Services or an outside company, e.g., Anesthesia Specialties) and written procedures have not changed (as per the Principal Investigator/Supervisor) and the measured over exposures are due to an employee’s lack of knowledge and/or continued procedural errors, these repeated over exposures will be addressed by the Institutional Animal Care and Use Committee (IACUC).

Note: IACUC determinations regarding repeated Isoflurane exposures will be presented at the next regularly scheduled SRS meeting. The SRS will review actions taken by the IACUC and determine by vote if these actions are acceptable; the SRS must be the final arbiter on issues involving safety.

6. **REFERENCES:**

29 CFR § 1910.1450—Occupational Exposure to Hazardous Chemicals in Laboratories.

29 CFR § 1910.1000 – Air contaminants (which includes part a, Table Z-1).

Medical Center Policy 138-133 RESPIRATORY PROTECTION.

Chemical Hygiene Policy 005 WASTE ANESTHETIC GASES AND VAPORS

VA Center for Engineering, Safety, and Occupational Health IH Guidebook, Hazardous Materials,
Section 11

7. **RESCISSION:** Work Involving Vapor Forming Chemicals in Research. The rescission date of this Standard Operating Procedure is August 9, 2027.

8. **FOLLOW-UP:** Research Safety Coordinator/Chemical Hygiene Officer.