

# Occupational Health Guideline for Selenium Hexafluoride

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formula:  $\text{SeF}_6$
- Synonyms: None
- Appearance: Colorless gas.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for selenium hexafluoride is 0.05 part of selenium hexafluoride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 0.4 milligram of selenium hexafluoride per cubic meter of air ( $\text{mg}/\text{m}^3$ ).

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Selenium hexafluoride can affect the body if it is inhaled or if it comes in contact with the eyes or skin.

### • Effects of overexposure

Animal experiments have shown selenium hexafluoride to be a severe respiratory irritant which has produced severe breathing difficulties. These breathing difficulties may be delayed in onset.

### • Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to selenium hexafluoride.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to selenium hexafluoride at potentially hazardous levels:

#### 1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory tract should be stressed.

—14" x 17" chest roentgenogram: Selenium hexafluoride causes lung damage in animals. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Selenium hexafluoride is a severe pulmonary irritant in animals. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is necessary only when indicated by the results of pulmonary function testing, or when signs and symptoms of respiratory disease occur.

### • Summary of toxicology

Selenium hexafluoride gas is a severe respiratory irritant in animals. Exposure of four animal species to 10 ppm for 4 hours was fatal; 5 ppm for 4 hours was not fatal but caused pulmonary edema, while 1 ppm produced no effects. Animals exposed to 5 ppm for 1 hour daily for 5 days developed signs of pulmonary injury; 1 ppm for the same time period caused no detectable effects.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 193
2. Boiling point (760 mm Hg):  $-35\text{ C}$  ( $-31\text{ F}$ )
3. Specific gravity (water = 1): 2.3 (liquid)
4. Vapor density (air = 1 at boiling point of selenium hexafluoride): 6.7
5. Melting point:  $-39\text{ C}$  ( $-38\text{ F}$ )
6. Vapor pressure at  $20\text{ C}$  ( $68\text{ F}$ ): Greater than 1 atmosphere
7. Solubility in water, g/100 g water at  $20\text{ C}$  ( $68\text{ F}$ ): Insoluble; reacts slowly

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

### U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service Centers for Disease Control  
National Institute for Occupational Safety and Health

### U.S. DEPARTMENT OF LABOR

Occupational Safety and Health Administration

8. Evaporation rate (butyl acetate = 1): Not applicable

• **Reactivity**

1. Conditions contributing to instability: None
2. Incompatibilities: None
3. Hazardous decomposition products: Data not available

4. Special precautions: None

• **Flammability**

1. Not combustible
2. See 29 CFR 1910.101 for specific regulations on storage of compressed gas cylinders.

• **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of selenium hexafluoride.

2. Eye Irritation Level: There is no indication in the available toxicological information that selenium hexafluoride produces eye irritation. Concerning fluorides, however, Grant states that "irritation of the eyes and nose has been reported when fluoride concentration has reached 5 mg/m<sup>3</sup> of air."

3. Evaluation of Warning Properties: Since no quantitative information is available relating warning properties to air concentrations of selenium hexafluoride, this compound is treated as a material with poor warning properties.

## MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with a subsequent chemical analysis of the adsorption tube. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure selenium hexafluoride may be used. An analytical method for selenium hexafluoride is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

## RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used

when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to selenium hexafluoride may occur and control methods which may be effective in each case:

Operation	Controls
Use as a gaseous electric insulator	Process enclosure; local exhaust ventilation; personal protective equipment
Use during production of selenium hydroxide and hydrofluoric acid, selenium and nitrogen	Process enclosure; local exhaust ventilation; personal protective equipment

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Breathing**

If a person breathes in large amounts of selenium hexafluoride, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

## LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of leaks until cleanup has been completed.
- If selenium hexafluoride is leaked, the following steps should be taken:

1. Ventilate area of leak.
2. Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair the leak or allow the cylinder to empty.

## REFERENCES

• American Conference of Governmental Industrial Hygienists: "Selenium Hexafluoride," *Documentation of*

*the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

• American Industrial Hygiene Association: "Selenium and Compounds," *Hygienic Guide Series*, Detroit, Michigan, 1959.

• Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

## RESPIRATORY PROTECTION FOR SELENIUM HEXAFLUORIDE

Condition	Minimum Respiratory Protection* Required Above 0.05 ppm
Gas Concentration	
0.5 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
2.5 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
5 ppm or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 5 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.  A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against selenium hexafluoride. Any escape self-contained breathing apparatus.

\*Only NIOSH-approved or MSHA-approved equipment should be used.