

Selenium Hexafluoride (SeF₆)

CAS 7783-79-1; UN 2194

Synonyms include selenium fluoride and selenium (VI) fluoride.

- ▼ **Persons exposed only to selenium hexafluoride gas do not pose secondary contamination risks.**
- ▼ **At room temperature, selenium hexafluoride is a colorless gas. It is not highly flammable, but when heated to high temperatures, it may decompose to produce toxic fumes (fluoride and selenium). Vapors from the liquified gas are initially heavier than air and spread along the ground. The odor of selenium hexafluoride may not provide adequate warning of hazardous concentrations.**
- ▼ **Selenium hexafluoride is absorbed by the lungs. Exposure causes inflammation and irritation of the skin, respiratory tract, and mucous membranes. Pulmonary edema may also occur after inhalation. Contact with the liquified gas may cause burns, severe injury, or frostbite.**

Description

Selenium hexafluoride is a colorless gas at room temperature. It is corrosive and highly toxic. Selenium hexafluoride should be stored in a cool, fireproof building with ventilation along the floor. Selenium hexafluoride is insoluble in water.

Routes of Exposure

Inhalation

Inhaled selenium hexafluoride is a highly toxic, corrosive, and irritating gas. It is absorbed from the lungs and is irritating to the upper respiratory tract even at low concentrations. No data as to odor threshold were located; **odor may not provide an adequate warning of potentially hazardous concentrations**. Selenium hexafluoride vapor is heavier than air, and asphyxiation in enclosed, poorly ventilated, or low-lying areas is possible.

Children exposed to the same levels of selenium hexafluoride vapor as adults may receive a larger dose because they have greater lung surface area:body weight ratios and higher minute volume:weight ratios. In addition, they may be exposed to higher levels than adults in the same location because of their short stature and the higher levels of selenium hexafluoride vapor found nearer to the ground.

Skin/Eye Contact

Direct contact with selenium hexafluoride gas causes rapid and severe eye and skin irritation or burns. Exposure to the liquified gas may produce burns, severe injury or frostbite.

Children are more vulnerable to toxicants affecting the skin because of their relatively larger surface area:body weight ratio. In addition, they maybe exposed to higher levels than adults in the same location because of their short stature and the higher levels of selenium hexafluoride found nearer to the ground.

Ingestion

Selenium hexafluoride is a gas at room temperature and ingestion is therefore unlikely.

Sources/Uses

Selenium hexafluoride is prepared by passing gaseous fluoride over finely divided selenium in a copper vessel.

Selenium hexafluoride is used as a gaseous electrical insulator.

Standards and Guidelines

OSHA PEL (permissible exposure limit) = 0.05 ppm, as selenium.

NIOSH IDLH (immediately dangerous to life or health) = 2 ppm.

Physical Properties

Description: Colorless gas.

Warning properties: none

Molecular weight: 192.95 daltons

Boiling point (760 mm Hg): sublimes at -51.88 °F (-46.6 °C)

Freezing point: - 59.44 °F (-50.8 °C)

Vapor pressure: 651.2 mm Hg at -55.66 °F (-48.7 °C)

Gas density: 6.7 (air = 1)

Specific gravity: 3.25 at -28 °C (water = 1)

Water solubility: insoluble

Flammability: not flammable

Flammable range: not flammable

Incompatibilities

Selenium hexafluoride reacts with water. Selenium hexafluoride also reacts with ammonia gas at 200 °C to give selenium, nitrogen, and hydrogen fluoride.

Health Effects

- ▼ **Selenium hexafluoride gas is corrosive and severely irritating to skin, eyes, and mucous membranes. Inhalation of selenium hexafluoride results in respiratory distress and pulmonary edema. Contact with the skin or eyes produces irritation and lacrimation, and can result in chemical burns, permanent tissue damage, or blindness. Contact with the liquified gas may cause burns, severe injury, or frostbite.**
- ▼ **Selenium hexafluoride decomposes into selenium and hydrofluoric acid on contact with moisture. No information was found as to whether the health effects of selenium hexafluoride in children are different than in adults. Exposure to selenium hexafluoride produces severe respiratory problems and individuals with pre-existing breathing difficulties or skin disease may be more susceptible to its effects.**

Acute Exposure

Selenium hexafluoride decomposes into selenium and hydrofluoric acid on contact with moisture. Onset of irritation is immediate, but pulmonary edema may be delayed several hours. Burns and damage to the eyes are progressive while any unneutralized fluoride ion remains.

Children do not always respond to chemicals in the same way that adults do. Different protocols for managing their care may be needed.

Respiratory

Selenium hexafluoride produces irritation of the respiratory tract, and can lead to pulmonary edema and death.

Children may be more vulnerable to corrosive agents because of the smaller diameter of their airways.

Children may be more vulnerable because of relatively higher minute ventilation per kg and failure to evacuate an area promptly when exposed.

Dermal

Selenium hexafluoride is a skin irritant. Contact with the liquified gas may cause burns, severe injury or frostbite. Burns are progressive while any unneutralized fluoride ion remains.

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants affecting the skin.

Ocular/Ophthalmic Selenium hexafluoride gas can cause eye irritation and damage to the cornea, exposure to the liquified gas can cause severe damage or blindness. Damage to the eyes is progressive while any unneutralized fluoride ion remains.

Potential Sequelae Tissue damage may be permanent; damage to the eyes may cause blindness. Exposure to selenium hexafluoride may result in electrolyte imbalance Selenium hexafluoride may trigger electrolyte imbalance similar to that elicited by hydrogen fluoride, since selenium hexafluoride readily decomposes to selenium and hydrogen fluoride upon contact with moisture. Refer to the Medical Management Guidelines for hydrogen fluoride for additional information.

Chronic Exposure Repeated contact with low concentrations of selenium hexafluoride may cause dermatitis, systemic toxicity characteristic of chronic selenium exposure, or fluorosis, a degenerative bone condition.

Chronic exposure may be more serious for children because of their potential longer latency period.

Carcinogenicity Selenium hexafluoride has not been classified for carcinogenicity.

Reproductive and Developmental Effects No studies were located that address reproductive or developmental effects of selenium hexafluoride in humans. Selenium hexafluoride is not included in *Reproductive and Developmental Toxicants*, a 1991 report published by the U.S. General Accounting Office (GAO) that lists 30 chemicals of concern because of widely acknowledged reproductive and developmental consequences.

Prehospital Management

- ▼ **Victims exposed only to selenium hexafluoride gas do not pose contamination risks to rescuers.**
- ▼ **Selenium hexafluoride is corrosive and irritating to mucous membranes, skin, eyes, and the respiratory system. Acute inhalation exposure may lead to respiratory distress and noncardiogenic pulmonary edema.**
- ▼ **There is no antidote for selenium hexafluoride. Treatment consists of respiratory and cardiovascular support.**

Hot Zone

Rescuers should be trained and appropriately attired before entering the Hot Zone. If the proper equipment is not available, or if rescuers have not been trained in its use, assistance should be obtained from a local or regional HAZMAT team or other properly equipped response organization.

Rescuer Protection

Selenium hexafluoride is a highly toxic gas, it is corrosive and severely irritating to the eyes, mucous membranes, respiratory tract, and skin. Selenium hexafluoride is not flammable, but when heated, decomposes to produce irritating, corrosive, and/or toxic gases.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to potentially unsafe levels of selenium hexafluoride.

Skin Protection: Chemical-protective clothing is recommended because selenium hexafluoride can cause skin irritation and burns. Fully encapsulating, vapor protective clothing should be worn to deal with spills or leaks with no fire.

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible.

Victim Removal

If victims can walk, lead them out of the Hot Zone to the Decontamination Zone. Victims who are unable to walk may be removed on backboards or gurneys; if these are not available, carefully carry or drag victims to safety.

Consider appropriate management of anxiety in victims with chemically-induced acute disorders, especially children who may suffer separation anxiety if separated from a parent or other adult.

Decontamination Zone

Patients exposed only to selenium hexafluoride vapor who have no skin or eye irritation may be transferred immediately to the Support Zone. Other patients will require decontamination as described below.

Rescuer Protection

If exposure levels are determined to be safe, decontamination may be conducted by personnel wearing a lower level of protection than that worn in the Hot Zone (described above).

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. Stabilize the cervical spine with a collar and a backboard if trauma is suspected. Administer supplemental oxygen as required. Assist ventilation with a bag-valve-mask device if necessary.

Basic Decontamination

Victims who are able may assist with their own decontamination. Decontamination is important as burns and damage to the eyes are progressive while any unneutralized fluoride ion remains.

Flush exposed skin and hair with copious amounts of water. Wash with soap and rinse thoroughly with water. Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers after decontamination as needed.

Flush exposed or irritated eyes with tepid water for 15 minutes. Remove contact lenses if easily removable without additional trauma to the eye. Continue eye irrigation during other basic care and transport. If pain or injury is evident, continue irrigation while transferring the victim to the Support Zone.

Consider appropriate management of chemically contaminated children at the exposure site. Provide reassurance to the child during decontamination, especially if separation from a parent occurs.

Transfer to Support Zone

As soon as basic decontamination is complete, move the victim to the Support Zone.

Support Zone

Be certain that victims have been decontaminated properly (see *Decontamination Zone*, above). Victims who have undergone decontamination or have been exposed only to vapor pose no

serious risks of secondary contamination to rescuers. In such cases, Support Zone personnel require no specialized protective gear.

ABC Reminders

Quickly establish a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Administer supplemental oxygen as required and establish intravenous access if necessary. Place on a cardiac monitor, if available.

In cases of contact with liquid (compressed gas), gently wash frosted skin with water; gently remove clothing from affected area. Dry with clean towels and keep victim warm and quiet.

Additional Decontamination

Continue irrigating exposed skin and eyes, as appropriate.

Advanced Treatment

Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyroidotomy by properly trained and equipped personnel.

Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Administer corticosteroids as indicated to patients who have persistent wheezing or hypersensitivity pneumonitis.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed, cautioning for myocardial variability.

Patients who are comatose, hypotensive, or having seizures or cardiac arrhythmias should be treated according to advanced life support (ALS) protocols.

Transport to Medical Facility

Only decontaminated patients or patients not requiring decontamination should be transported to a medical facility. “Body bags” are not recommended.

Report to the base station and the receiving medical facility the condition of the patient, treatment given, and estimated time of arrival at the medical facility.

Multi-Casualty Triage

Consult with the base station physician or the regional poison control center for advice regarding triage of multiple victims.

Patients who are seriously symptomatic (as in cases of chest tightness or wheezing), and patients who have histories or evidence of significant exposure should be transported to a medical facility for evaluation. Others may be discharged at the scene after their names, addresses, and telephone numbers are recorded. Those discharged should be advised to seek medical care promptly if symptoms develop (see *Patient Information Sheet* below).

Emergency Department Management

- ▼ **Patients do not pose a contamination risk to hospital personnel.**
- ▼ **Selenium hexafluoride is corrosive and irritating to mucous membranes, skin, eyes, and the respiratory tract. Acute inhalation exposure may lead to respiratory distress and noncardiogenic pulmonary edema.**
- ▼ **There is no antidote for selenium hexafluoride. Treatment consists of respiratory and cardiovascular support.**

Decontamination Area

Unless previously decontaminated, all victims with skin or eye irritation require decontamination as described below. All other patients may be transferred immediately to the Critical Care Area.

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants absorbed through the skin. Also emergency room personnel should examine children's mouths because of the frequency of hand-to-mouth activity among children.

ABC Reminders

Treat cases of respiratory compromise, coma, or excessive pulmonary secretions with respiratory support using protocols and techniques available and within the scope of training. Some cases may necessitate procedures such as endotracheal intubation or cricothyroidotomy by properly trained and equipped personnel.

Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Administer corticosteroids as indicated to patients who have persistent wheezing or hypersensitivity pneumonitis.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed, cautioning for myocardial variability.

Patients who are comatose, hypotensive, or have seizures or ventricular arrhythmias should be treated in the conventional manner.

Basic Decontamination

Patients who are able may assist with their own decontamination. Decontamination is important as burns and damage to the eyes are progressive while any unneutralized fluoride ion remains.

Flush exposed skin and hair with water for 2 to 3 minutes (preferably under a shower), then wash thoroughly with mild soap. Rinse thoroughly with water. In case of frostbite injury, irrigate with lukewarm (42 °C) water according to standard treatment. Use caution to avoid hypothermia when decontaminating victims, particularly children or the elderly. Use blankets or warmers after decontamination as needed.

Flush exposed eyes with plain tepid water for at least 15 minutes. Remove contact lenses if easily removable without additional trauma to the eye. If pain or injury is evident, continue irrigation while transporting the patient to the Critical Care Area.

Critical Care Area

Be certain that appropriate decontamination has been carried out (see *Decontamination Area* above).

ABC Reminders

Evaluate and support airway, breathing, and circulation as in ABC Reminders above under *Decontamination Zone*. Establish intravenous access in seriously ill patients if this has not been done previously. Continuously monitor cardiac rhythm.

Patients who are comatose, hypotensive, or have seizures or cardiac arrhythmias should be treated in the conventional manner.

Inhalation Exposure

Administer supplemental oxygen by mask to patients who have respiratory symptoms. Treat patients who have bronchospasm with an aerosolized bronchodilator such as albuterol. Administer corticosteroids as indicated to patients who have persistent wheezing or hypersensitivity pneumonitis.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed, cautioning for myocardial variability.

Skin Exposure

If the skin was in contact with selenium hexafluoride gas chemical burns may occur; treat as thermal burns. Flush exposed skin for at least 20 minutes. Contact with the liquified gas may produce frostbite. In case of frostbite injury, irrigate with lukewarm (42 °C) water according to standard treatment. Burns may be treated with

a calcium gluconate gel or slurry in water or glycerine to remove fluoride ions and relieve pain.

Because of their relatively larger surface area:body weight ratio, children are more vulnerable to toxicants affecting the skin.

Eye Exposure

Continue irrigation for at least 15 minutes. In case of frostbite injury, ensure that thorough warming with lukewarm water or saline has been completed. Test visual acuity. Examine the eyes for corneal damage and treat appropriately. Immediately consult an ophthalmologist for patients who have corneal injuries.

*Antidotes and
Other Treatments*

There is no antidote for selenium hexafluoride. Treatment is supportive of respiratory and cardiovascular functions.

Laboratory Tests

Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. An EKG should be performed if significant exposure is suspected. Patients who have respiratory complaints may require pulse oximetry (or ABG measurements), chest radiography, and peak-flow spirometry.

**Disposition and
Follow-up**

Consider hospitalizing patients who have histories of significant inhalation exposure and are symptomatic (e.g., chest tightness or wheezing).

Delayed Effects

Pulmonary edema may be delayed for several hours after inhalation exposure. Burns and damage to the eyes are progressive while any unneutralized fluoride ion remains.

Patient Release

Patients who remain asymptomatic for 24 hours after exposure may be discharged with instructions to seek medical care promptly if symptoms develop (see the *Selenium hexafluoride—Patient Information Sheet* below).

Follow-up

Obtain the name of the patient's primary care physician so that the hospital can send a copy of the ED visit to the patient's doctor.

If significant inhalation or skin contact has occurred, monitor pulmonary function.

Patients who have corneal injuries should be reexamined within 24 hours.

Reporting

If a work-related incident has occurred, you may be legally required to file a report; contact your state or local health department.

Other persons may still be at risk in the setting where this incident occurred. If the incident occurred in the workplace, discussing it with company personnel may prevent future incidents. If a public health risk exists, notify your state or local health department or other responsible public agency. When appropriate, inform patients that they may request an evaluation of their workplace from OSHA or NIOSH. See Appendix III for a list of agencies that may be of assistance.

Selenium hexafluoride Patient Information Sheet

This handout provides information and follow-up instructions for persons who have been exposed to selenium hexafluoride.

What is selenium hexafluoride?

Selenium hexafluoride is a corrosive, colorless gas. Selenium hexafluoride is used as a gaseous electrical insulator.

What immediate health effects can be caused by exposure to selenium hexafluoride?

Low levels of selenium hexafluoride in the air can irritate the eyes, nose, throat, and lungs and cause cough, chest tightness, and shortness of breath. Higher levels can cause a build-up of fluid in the lungs, which may cause death. If the liquified gas comes in contact with the skin or eyes, it can cause severe burns or frostbite. Generally, the more serious the exposure, the more severe the symptoms.

Can selenium hexafluoride poisoning be treated?

There is no antidote for selenium hexafluoride, but its effects can be treated and most exposed persons get well. Seriously exposed persons may need to be hospitalized.

Are any future health effects likely to occur?

In rare cases, after exposure to selenium hexafluoride, certain persons can develop allergies in which even small exposures to selenium hexafluoride or other irritants can trigger skin irritation. Therefore, it is important to tell your doctor that you have been exposed to selenium hexafluoride.

What tests can be done if a person has been exposed to selenium hexafluoride?

Specific tests for the presence of selenium hexafluoride in blood are not available. If a severe exposure has occurred, respiratory function tests and a chest x-ray may show whether damage has been done to the lungs. Testing is not needed in every case.

Where can more information about selenium hexafluoride be found?

More information about selenium hexafluoride can be obtained from your regional poison control center; your state, county, or local health department; the Agency for Toxic Substances and Disease Registry (ATSDR); your doctor, or a clinic in your area that specializes in occupational and environmental health. If the exposure happened at work, you may wish to discuss it with your employer, the Occupational Safety and Health Administration (OSHA), or the National Institute for Occupational Safety and Health (NIOSH). Ask the person who gave you this form for help in locating these telephone numbers.

Follow-up Instructions

Keep this page and take it with you to your next appointment. Follow *only* the instructions checked below.

Call your doctor or the Emergency Department if you develop any unusual signs or symptoms within the next 24 hours, especially:

- coughing, wheezing, difficulty breathing, shortness of breath, or chest pain
- increased pain or a discharge from your eyes
- increased redness or pain or a pus-like discharge in the area of a skin burn

No follow-up appointment is necessary unless you develop any of the symptoms listed above.

Call for an appointment with Dr. _____ in the practice of _____.

When you call for your appointment, please say that you were treated in the Emergency Department at _____ Hospital by _____ and were advised to be seen again in _____ days.

Return to the Emergency Department/ _____ Clinic on (date) _____ at _____ AM/PM for a follow-up examination.

Do not perform vigorous physical activities for 1 to 2 days.

You may resume everyday activities including driving and operating machinery.

Do not return to work for _____ days.

You may return to work on a limited basis. See instructions below.

Avoid exposure to cigarette smoke for 72 hours; smoke may worsen the condition of your lungs.

Avoid drinking alcoholic beverages for at least 24 hours; alcohol may worsen injury to your stomach or have other effects.

Avoid taking the following medications: _____

You may continue taking the following medication(s) that your doctor(s) prescribed for you: _____

Other instructions: _____

• Provide the Emergency Department with the name and the number of your primary care physician so that the ED can send him or her a record of your emergency department visit.

• You or your physician can get more information on the chemical by contacting: _____ or _____, or by checking out the following Internet Web sites: _____; _____.

Signature of patient _____ Date _____

Signature of physician _____ Date _____