

# Occupational Health Guideline for Sulfur Pentafluoride

## 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:  $S_2F_{10}$
- Synonyms: Disulfur decafluoride
- Appearance and odor: Colorless liquid or gas with an odor like sulfur dioxide.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for sulfur pentafluoride is 0.025 part of sulfur pentafluoride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 0.25 milligram of sulfur pentafluoride per cubic meter of air ( $mg/m^3$ ).

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Sulfur pentafluoride can affect the body if it is inhaled. No data could be found in the literature which specifically reported possible effects of eye or skin contact with the liquid or the effects of ingestion.

### • Effects of overexposure

1. *Short-term Exposure:* In animals, inhalation has been reported to cause severe breathing difficulties.

2. *Long-term Exposure:* Not known

3. *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 sulfur pentafluoride.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to sulfur

pentafluoride 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 system and the cardiovascular system should be stressed.

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

—FVC and FEV (1 sec): Sulfur pentafluoride is a respiratory irritant. 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 by signs and symptoms of respiratory disease.

### • Summary of toxicology

Sulfur pentafluoride vapor is a severe pulmonary irritant. Exposure of rats to 1 ppm for 16 to 18 hours was fatal; 0.5 ppm caused pulmonary edema and hemorrhage; 0.1 ppm caused irritation of the lungs; 0.01 ppm had no discernible effects. Nonfatal exposure of rats for 1 hour to 10 ppm caused pulmonary hemorrhage. In rabbits the LD50 for intravenous injection of a lecithin emulsion of sulfur pentafluoride was 5.8 mg/kg; at autopsy the chief lesion was massive pulmonary edema with frequent hemorrhage, apparently a result of widespread endothelial damage to the cardiovascular system.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 254
2. Boiling point (760 mm Hg): 29 C (84 F)
3. Specific gravity (water = 1): 2.08 (at 0 C)
4. Vapor density (air = 1 at boiling point of sulfur

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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.

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Public Health Service Centers for Disease Control  
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pentafluoride): 8.75

5. Melting point:  $-55\text{ C}$  ( $-67\text{ F}$ )
6. Vapor pressure at  $20\text{ C}$  ( $68\text{ F}$ ): 561 mm Hg
7. Solubility in water, g/100 g water at  $20\text{ C}$  ( $68\text{ F}$ ):

Insoluble

8. Evaporation rate (butyl acetate = 1): Much greater than 1

- **Reactivity**

1. Conditions contributing to instability: Temperatures above  $400\text{ C}$  ( $752\text{ F}$ ) cause decomposition and development of pressure in containers.

2. Incompatibilities: None
3. Hazardous decomposition products: None
4. Special precautions: None

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: No quantitative information is available.

2. Eye Irritation Level: According to the International Labour Office (ILO), "no data are available on its effects on the upper respiratory tract and conjunctivae."

3. Evaluation of Warning Properties: Since no quantitative information available relating its warning properties to air concentrations, sulfur pentafluoride 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**

At the time of publication of this guideline, no measurement method for sulfur pentafluoride had been published by NIOSH.

## 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.

## PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid sulfur pentafluoride or liquids containing sulfur pentafluoride.

- Clothing contaminated with sulfur pentafluoride should be stored in such a manner that the sulfur pentafluoride is not dispersed until it can be discarded, or until provision is made for the removal of sulfur pentafluoride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the sulfur pentafluoride, the person performing the operation should be informed of sulfur pentafluoride's hazardous properties.

- Where there is any possibility of exposure of an employee's body to liquid sulfur pentafluoride, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with sulfur pentafluoride should be removed immediately and not reworn until the sulfur pentafluoride is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid sulfur pentafluoride or liquids containing sulfur pentafluoride contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to liquid sulfur pentafluoride or liquids containing sulfur pentafluoride, an eye-wash fountain should be provided within the immediate work area for emergency use.

- Employees should immediately evacuate the area whenever sulfur pentafluoride is accidentally released into the workplace air.

## COMMON OPERATIONS AND CONTROLS

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

## Operation

Liberation as a by-product during synthesis of sulfur hexafluoride (This compound is considered more toxic than phosgene and is not produced commercially).

## Controls

Provisions should be made to exit vapors so that they are absorbed by activated alumina and soda lime

## EMERGENCY FIRST AID PROCEDURES

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

### • Eye Exposure

If liquid sulfur pentafluoride or liquids containing sulfur pentafluoride get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If liquid sulfur pentafluoride or liquids containing sulfur pentafluoride get on the skin, immediately flush the contaminated skin with water. If liquid sulfur pentafluoride or liquids containing sulfur pentafluoride penetrate through the clothing, remove the clothing immediately and flush the skin with water. If irritation is present after washing, get medical attention immediately.

### • Breathing

If a person breathes in large amounts of sulfur pentafluoride, 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.

### • Swallowing

If liquid sulfur pentafluoride or liquids containing sulfur pentafluoride have been swallowed and the person is conscious, give him large quantities of water immediately to dilute the sulfur pentafluoride. Do not attempt to make the exposed person vomit. Get medical attention immediately.

### • 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.

## SPILL AND LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of leaks until cleanup has been completed.
- If sulfur pentafluoride is spilled or 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.
  3. If liquid, allow liquid to evaporate.

## ADDITIONAL INFORMATION

To find additional information on sulfur pentafluoride, look up sulfur pentafluoride in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

## REFERENCES

- American Conference of Governmental Industrial Hygienists: "Sulfur Pentafluoride," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- Greenberg, L. A., and Lester, D.: "The Toxicity of Sulfur Pentafluoride," *A.M.A. Archives of Industrial Hygiene and Occupational Medicine*, 2:350-352, 1950.
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- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
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## RESPIRATORY PROTECTION FOR SULFUR PENTAFLUORIDE

Condition	Minimum Respiratory Protection* Required Above 0.025 ppm
Vapor Concentration	
0.25 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
1 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 1 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 acid gases. Any escape self-contained breathing apparatus.

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