

Occupational Health Guideline for Sulfuryl Fluoride

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: SO_2F_2
- Synonyms: None
- Appearance and odor: Colorless and odorless gas.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for sulfuryl fluoride is 5 parts of sulfuryl fluoride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 20 milligrams of sulfuryl fluoride per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Sulfuryl fluoride can affect the body if it is inhaled or if it comes in contact with the eyes.

• Effects of overexposure

1. Short-term Exposure: Animal experiments have shown that inhalation of sulfuryl fluoride may cause shaking, convulsions, and severe breathing difficulties. Human exposure to a mixture of sulfuryl fluoride and an irritant gas caused nausea, vomiting, crampy abdominal pain, itching, reddening of the eyes, nose, and throat, and minor lung changes. These effects were of short duration.

2. Long-term Exposure: Animal experiments have shown that repeated exposure to sulfuryl fluoride may cause mottled teeth and kidney and lung injury.

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 sulfuryl fluoride.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to sulfuryl fluoride 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 central nervous system should be stressed.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Sulfuryl fluoride gas is a respiratory irritant and a depressant of the central nervous system. Although there are few details, exposure of animals to an unspecified but high concentration caused signs of narcosis and, in some instances, tremor, convulsions, and pulmonary edema; repeated exposure caused lung and kidney injury. A worker who was exposed to an undetermined concentration of a mixture of sulfuryl fluoride and an undesignated irritant gas for 4 hours developed nausea, vomiting, abdominal pain, and pruritis; examination revealed conjunctivitis, rhinitis, pharyngitis, diffuse rhonchi, and paresthesia of the right leg, all of which rapidly subsided.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 102.1
2. Boiling point (760 mm Hg): -55.2 C (-67 F)
3. Specific gravity (water = 1): 1.36 (liquid)
4. Vapor density (air = 1 at boiling point of sulfuryl fluoride): 3.5
5. Melting point: -136.7 C (-213 F)
6. Vapor pressure at 20 C (68 F): Greater than 1

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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atmosphere

7. Solubility in water, g/100 g water at 20 C (68 F): 0.16

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

• **Reactivity**

1. Conditions contributing to instability: High temperatures may cause cylinders to burst.

2. Incompatibilities: None

3. Hazardous decomposition products: Toxic gases and vapors (such as sulfur dioxide and hydrogen fluoride) may be released when sulfuryl fluoride decomposes.

4. Special precautions: See 29 CFR 1910.101 for specific regulations on storage of compressed gas cylinders.

• **Flammability**

1. Not combustible

• **Warning properties**

1. Odor Threshold: Spector states that sulfuryl fluoride is odorless.

2. Eye Irritation Level: Baskin states that sulfuryl fluoride is severely irritating to the eyes. Other sources do not mention this severe eye irritation, however, and no quantitative information is available concerning the threshold of eye irritation. Gleason states that "chronic exposure . . . to 100 ppm resulted in no adverse effects on rats, rabbits, guinea pigs, or monkeys."

3. Other Information: Baskin states that sulfuryl fluoride is severely irritating to the mucous membranes of the respiratory tract. No quantitative information is available concerning the threshold of this irritation, however.

4. Evaluation of Warning Properties: Since sulfuryl fluoride is odorless, and since no quantitative information is available relating its irritant effects to air concentrations, this substance is treated as a material with poor warning properties. Taxay states that sulfuryl fluoride has no 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**

An analytical method for sulfuryl fluoride is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office,

Washington, D.C. 20402 (GPO No. 017-033-00369-6).

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 sulfuryl fluoride may occur and control methods which may be effective in each case:

| Operation | Controls |
|---|--|
| Liberation during use as an insecticidal fumigant for control of dry wood termites and other structural pests | Process enclosure; mix with alerting gas |

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 strong concentrations of sulfuryl fluoride gas get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Breathing**

If a person breathes in large amounts of sulfuryl fluoride, 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. Under-

stand 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 sulfuranyl fluoride is leaked, the following steps should be taken:
 1. Ventilate area of leak to disperse gas.
 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 into a mixed solution of caustic soda and slaked lime.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Sulfuryl Fluoride," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- Baskin, A. D. (ed.): *Handling Guide for Potentially Hazardous Commodities, Railway Systems and Management Association*, Chicago, 1972.
- Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.
- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.
- Taxay, E. P.: "Vikane Inhalation," *Journal of Occupational Medicine*, 8:425-426, 1966.

RESPIRATORY PROTECTION FOR SULFURYL FLUORIDE

| Condition | Minimum Respiratory Protection* Required Above 5 ppm |
|---|---|
| Gas Concentration | |
| 50 ppm or less | Any supplied-air respirator. Any self-contained breathing apparatus. |
| 250 ppm or less | Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. |
| 1000 ppm or less | A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode. |
| Greater than 1000 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 sulfuranyl fluoride. Any escape self-contained breathing apparatus. |

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