

Occupational Health Guideline for Sulfur Monochloride

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_2Cl_2
- Synonyms: Sulfur chloride; sulfur subchloride
- Appearance and odor: Amber to red fuming, oily liquid with a pungent, nauseating, and irritating odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for sulfur monochloride is 1 part of sulfur monochloride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 6 milligrams of sulfur monochloride per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Sulfur monochloride can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Vapors of sulfur monochloride may cause coughing, and tearing and burning of the eyes which may be delayed in onset. Inhalation of high concentrations of sulfur monochloride may cause severe difficulty in breathing and symptoms of chemical pneumonia. If splashed on the skin, sulfur monochloride liquid may cause irritation, and, if allowed to remain on the skin, a burn. If the liquid is splashed in the eyes, it may produce severe, immediate damage and scarring.

2. Long-term Exposure: Repeated exposure of the skin, eyes, or upper respiratory tract to sulfur monochloride may cause chronic irritation.

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 monochloride.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to sulfur monochloride 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, skin, and eyes should be stressed.

—14" x 17" chest roentgenogram: Sulfur monochloride is a respiratory irritant. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Sulfur monochloride 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 monochloride is a severe irritant of the eyes, mucous membranes, and skin. On contact with water it decomposes to form hydrogen chloride and sulfur dioxide; since this occurs rapidly, it acts primarily as an upper respiratory irritant and does not ordinarily reach the lungs. Exposure of mice to 150 ppm for 1 minute is fatal. In humans, exposure to the vapor causes lacrimation and cough; exposure to high concentrations may cause pulmonary edema. Concentrations of 2 to 9 ppm are reported to be mildly irritating. Splashes of the

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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liquid in the eyes will produce severe immediate damage which may result in permanent scarring. The liquid on the skin will produce irritation and burns if not removed.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 135
2. Boiling point (760 mm Hg): 138 C (280 F)
3. Specific gravity (water = 1): 1.7
4. Vapor density (air = 1 at boiling point of sulfur monochloride): 4.66
5. Melting point: -76 C (-105 F)
6. Vapor pressure at 20 C (68 F): 6.8 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Reacts violently, forming hydrochloric acid

8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Temperatures above 300 C (572 F) cause decomposition to toxic chlorine gas and solid sulfur.

2. Incompatibilities: Contact with peroxides, oxides of phosphorus, and some organic matter may cause fires and explosions. Contact with water causes a violent reaction, forming hydrogen chloride gas (or hydrochloric acid), which may corrode metal containers and form flammable hydrogen gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, sulfur dioxide, hydrogen sulfide, and carbon monoxide) may be released in a fire involving sulfur monochloride.

4. Special precautions: Sulfur monochloride will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 118.5 C (245 F) (closed cup)
2. Autoignition temperature: 234 C (453 F)
3. Flammable limits in air, % by volume: Data not available

4. Extinguishant: Carbon dioxide, dry chemical

• Warning properties

1. Odor Threshold: No information is available concerning the odor threshold of sulfur monochloride.

2. Eye Irritation Level: According to Grant, "even 2 to 9 ppm in air are said to be mildly irritating to the eyes."

3. Evaluation of Warning Properties: Since sulfur monochloride causes eye irritation within twice the permissible exposure limit, this substance is treated as a material with good 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 monochloride 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 monochloride.

• Clothing contaminated with sulfur monochloride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of sulfur monochloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the sulfur monochloride, the person performing the operation should be informed of sulfur monochloride's hazardous properties.

• Where there is any possibility of exposure of an employee's body to liquid sulfur monochloride, 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 monochloride should be removed immediately and not reworn until the sulfur monochloride 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 monochloride contacting the eyes.

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

SANITATION

- Skin that becomes contaminated with sulfur monochloride should be immediately washed or showered to remove any sulfur monochloride.
- Employees who handle liquid sulfur monochloride should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use for production of white vulcanized oils used for coating and impregnating textiles; use as natural and synthetic rubber extenders and modifying agents in erasers, and extruded rubber goods	Process enclosure; local exhaust ventilation; personal protective equipment
Use with unsaturated fatty acids in production of additives to extreme pressure lubricants and cutting oils	Process enclosure; local exhaust ventilation; personal protective equipment
Use as a cross-linking catalyst in polymer technology; use in chemical synthesis for production of intermediates for dyes, pharmaceuticals, insecticides, and war gases	Process enclosure; local exhaust ventilation; personal protective equipment
Use for treatment of drying oils for production of varnishes, inks, paints, and cements; use for cold vulcanizing of thin rubber articles; use as a solvent for sulfur and sulfur compounds	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.

• Eye Exposure

If liquid sulfur monochloride or strong concentrations of sulfur monochloride vapor 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 monochloride or strong concentrations of sulfur monochloride vapor get on the skin, immediately flush the contaminated skin with water. If liquid sulfur monochloride or strong concentrations of sulfur monochloride vapor penetrate through the clothing, remove the clothing immediately and flush the skin with water. If irritation is present after washing, get medical attention.

• Breathing

If a person breathes in large amounts of sulfur monochloride, 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 monochloride has been swallowed and the person is conscious, give the person large quantities of water immediately to dilute the sulfur monochloride. Do not induce vomiting. 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 DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

- If sulfur monochloride is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Spray on a thick layer of a (1:1) mixture of dry soda ash and slaked lime. Mix and spray on water slowly, then add large amounts of water. The neutralized solution can then be disposed in a secured sanitary landfill.

- Waste disposal method:

Sulfur monochloride may be disposed of by using (2) above.

REFERENCES

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- Sax, N. I.: *Dangerous Properties of Industrial Materials* (4th ed.), Van Nostrand Reinhold, New York, 1975.

RESPIRATORY PROTECTION FOR SULFUR MONOCHLORIDE

Condition	Minimum Respiratory Protection* Required Above 1 ppm
Vapor Concentration	
10 ppm or less	A chemical cartridge respirator with a full facepiece and cartridge(s) for hydrogen chloride and sulfur dioxide. A gas mask with a chin-style or a front- or back-mounted canister for hydrogen chloride and sulfur dioxide. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 10 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 hydrogen chloride and sulfur dioxide. Any escape self-contained breathing apparatus.

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