

Occupational Health Guideline for Bromoform

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: CHBr_3
- Synonyms: Tribromomethane
- Appearance and odor: Colorless to yellow liquid with an odor like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for bromoform is 0.5 part of bromoform per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 5 milligrams of bromoform per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Bromoform can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin.

• Effects of overexposure

1. Short-term Exposure: Bromoform can cause irritation of the eyes, nose, and throat. Swallowing bromoform may also cause dizziness, disorientation and slurred speech, unconsciousness, and death.

2. Long-term Exposure: Bromoform may cause liver damage.

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 bromoform.

• Recommended medical surveillance

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

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from bromoform exposure.

—Skin disease: Bromoform can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Bromoform has been reported to be a liver toxin in animals, and justifies consideration before exposing persons with impaired liver function.

—Kidney disease: Although bromoform is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of bromoform might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Bromoform vapor is a respiratory irritant, a narcotic, and an hepatotoxin. A saturated atmosphere of 7000 ppm or more produced anesthesia in dogs in 8 minutes and death in 60 minutes, with evidence of respiratory irritation and liver damage. Human exposure to the vapor causes irritation of the eyes and throat. Accidental ingestion of the liquid by children produced central nervous system depression with coma and loss of reflexes; smaller doses led to listlessness, headache, and vertigo. Chronic effects have not been reported from

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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industrial exposure. Skin absorption is said to have been demonstrated.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 252.8
2. Boiling point (760 mm Hg): 148 C (298 F)
3. Specific gravity (water = 1): 2.85
4. Vapor density (air = 1 at boiling point of bromoform): 8.7
5. Melting point: 7.8 C (46 F)
6. Vapor pressure at 20 C (68 F): 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.1
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Bromoform reacts with chemically active metals such as sodium, potassium, calcium, powdered aluminum, zinc, and magnesium, and strong caustics.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen bromide and bromine) may be released in a fire involving bromoform.
4. Special precautions: Liquid bromoform will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Not combustible

• Warning properties

According to Patty, bromoform has a chloroformlike odor and is highly irritating. Since the TLV for bromoform was determined by taking into consideration its irritant effects, for the purposes of this guideline, bromoform is treated as a material with adequate warning properties.

Bromoform is an eye irritant, according to the *Documentation of TLV's*.

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 bromoform vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure bromoform may

be used. An analytical method for bromoform is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

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.

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 repeated or prolonged skin contact with liquid bromoform.
- Non-impervious clothing which becomes contaminated with liquid bromoform should be removed promptly and not reworn until the bromoform is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid bromoform may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid bromoform should be promptly washed or showered with soap or mild detergent and water to remove any bromoform.
- Eating and smoking should not be permitted in areas where bromoform is handled, processed, or stored.
- Employees who handle bromoform should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

COMMON OPERATIONS AND CONTROLS

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

| Operation | Controls |
|---|---|
| Use as a heavy liquid flotation agent in mineral separation-sedimentary petrographical surveys, geological assays, and purification of materials such as quartz | Local exhaust ventilation; general dilution ventilation; personal protective equipment |
| Use in chemical and pharmaceutical synthesis in condensation reactions, and source of free radicals to initiate transformation of various compounds | Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment |
| Use as an industrial solvent in liquid-solvent extractions in nuclear magnetic resonance studies | Local exhaust ventilation; general dilution ventilation; personal protective equipment |
| Use as a flame retardant in compositions for cellulose and in microencapsulation | General dilution ventilation |
| Use as a catalyst, initiator, or sensitizer in polymer production, irradiation reactions, and vulcanization of rubber | Local exhaust ventilation; general dilution ventilation |
| Use as an ingredient in pharmaceuticals or medicinal products | Material substitution |

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 bromoform gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If bromoform gets on the skin, promptly wash the contaminated skin using soap or mild detergent and

water. If bromoform soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of bromoform, 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

When bromoform has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• 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, LEAK, AND DISPOSAL PROCEDURES

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

• If bromoform is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Bromoform may be disposed of by absorbing it in vermiculite, dry sand, earth, or a similar material and disposing in a secured sanitary landfill.

REFERENCES

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RESPIRATORY PROTECTION FOR BROMOFORM

| Condition | Minimum Respiratory Protection* Required Above 0.5 ppm |
|---|---|
| Vapor Concentration | |
| 25 ppm or less | A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. 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 organic vapors. Any escape self-contained breathing apparatus. |

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

