

Occupational Health Guideline for Trifluoromonobromomethane

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: CBrF_3
- Synonyms: Halocarbon 13B1; Refrigerant 13B1; bromotrifluoromethane; Halon 1301
- Appearance and odor: Colorless gas with a slight ethereal odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for trifluoromonobromomethane is 1000 parts of trifluoromonobromomethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 6100 milligrams of trifluoromonobromomethane per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Trifluoromonobromomethane can affect the body if it is inhaled. It may also affect the body if the liquid comes in contact with the eyes or skin.

• Effects of overexposure

1. *Short-term Exposure:* Breathing high concentrations of trifluoromonobromomethane may cause lightheadedness. Breathing very high concentrations of trifluoromonobromomethane may cause the heart to beat irregularly or stop.

2. *Long-term Exposure:* None 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 trifluoromonobromomethane.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to trifluoromonobromomethane 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 trifluoromonobromomethane exposure.

—Cardiovascular disease: In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the breathing of trifluoromonobromomethane might cause exacerbation of symptoms due to its sensitizing properties.

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

• Summary of toxicology

Trifluoromonobromomethane vapor is a narcotic at high concentrations. In dogs and rats repeatedly exposed to 23,000 ppm there were no toxic signs or pathologic changes. Monkeys exposed to concentrations of 20% (200,000 ppm) became lethargic and suffered spontaneous cardiac arrhythmias within 5 to 40 seconds of exposure. In animal exposure studies at high levels, sensitization of the myocardium to epinephrine was reported. In human experiments designed to determine the safety of the substance as a firefighting agent in airplane cabins, exposure of three volunteers at 7% (70,000 ppm) for three minutes produced no cardiac anomalies.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 149
2. Boiling point (760 mm Hg): $-57.8\text{ C } (-72\text{ F})$
3. Specific gravity (water = 1): 1.54 at 77 F

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR

Occupational Safety and Health Administration

- 4. Vapor density (air = 1 at boiling point of trifluoromonobromomethane): 5
- 5. Melting point: -168 C (-270 F)
- 6. Vapor pressure at 20 C (68 F): Not pertinent
- 7. Solubility in water, g/100 g water at 20 C (68 F): 0.03
- 8. Evaporation rate (butyl acetate = 1): Not pertinent

• **Reactivity**

- 1. Conditions contributing to instability: Heat
- 2. Incompatibilities: Reacts with chemically active metals, calcium, or with powdered aluminum, zinc, and magnesium.
- 3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen bromide, carbonyl fluoride, hydrogen fluoride, and carbon monoxide) may be released when trifluoromonobromomethane decomposes.
- 4. Special precautions: Liquid trifluoromonobromomethane will attack some forms of plastics, rubber, and coatings.

• **Flammability**

- 1. Not combustible

• **Warning properties**

Trifluoromonobromomethane does not have adequate warning properties.
Trifluoromonobromomethane is not a known eye irritant.

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 vapors using an adsorption tube with subsequent desorption with methylene chloride and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure trifluoromonobromomethane may be used. An analytical method for trifluoromonobromomethane 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.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as commercial and military fire extinguishant; use as a refrigerant for food processing and storage; use as a blowing agent to improve flame retardancy of rigid polyurethane foams	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in organic synthesis in production of olefin resins; use during the manufacture of hydraulic fluids as an erosion inhibitor	General dilution ventilation; local exhaust ventilation; personal protective equipment
Liberation during use for special purposes in bubble chambers for ionization studies, in "quark" detection, and in radiation counters	General dilution ventilation; 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.

• **Breathing**

If a person breathes in large amounts of trifluoromonobromomethane, 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. Understand 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 trifluoromonobromomethane is leaked, the following steps should be taken:

1. Ventilate area of leak.
2. Stop flow of gas.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Trifluoromonobromomethane," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- E. I. DuPont de Nemours and Company: *Freon Compounds and Safety - Trifluoromonobromomethane*, Wilmington, Delaware.
- E. I. DuPont de Nemours and Company: *Freon Product Information - Trifluoromonobromomethane*, Wilmington, Delaware.
- National Academy of Sciences: "Symposium on An Appraisal of Halogenated Fire Extinguishing Agents," Washington, D. C., April 11-12, 1972.
- Smith, D. G., and Harris, D. J.: "Human Exposure to Halon 1301 (CBrF₃) during Simulated Aircraft Cabin Fires," *Aerospace Medicine*, 44:198-201, 1973.
- Van Stee, E. W., and Back, K. C.: "Short Term Inhalation of Bromotrifluoromethane," *Toxicology and Applied Pharmacology*, 15:164-174, 1969.

RESPIRATORY PROTECTION FOR TRIFLUOROMONOBROMOMETHANE

Condition	Minimum Respiratory Protection* Required Above 1000 ppm
Gas Concentration	
10,000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
50,000 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 with a half-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 50,000 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.