

Occupational Health Guideline for Ethyl Bromide

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: C_2H_5Br
- Synonyms: Bromoethane
- Appearance and odor: Colorless to yellow liquid with an ether-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethyl bromide is 200 parts of ethyl bromide per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 890 milligrams of ethyl bromide per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Ethyl bromide 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**
Exposure to ethyl bromide may cause irritation of the lungs, eyes, and skin. It may cause dizziness, loss of balance, slurred speech, unconsciousness, and death. Overexposure to this agent may also cause damage to the liver, kidneys, and heart. After-effects from severe exposure may occur up to 30 hours after the exposure has ceased.
- **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 ethyl bromide.

- **Recommended medical surveillance**

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

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

—Liver disease: Ethyl bromide has produced liver damage in animals and man, which should be considered before exposing persons with impaired liver function.

—Kidney disease: Since ethyl bromide has produced kidney damage in animals and man, special consideration in those with impaired renal function is justified.

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

—Cardiovascular disease: In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the inhalation of ethyl bromide might cause exacerbation of disorders of the conduction mechanism due to its sensitizing effects on the myocardium.

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

- **Summary of toxicology**

Ethyl bromide vapor is a respiratory irritant, a narcotic, and a hepato- and renal toxin. Exposure of guinea pigs for 30 minutes to 2.4% by volume (24,000 ppm) was fatal within 3 days due to pulmonary congestion, centrilobular necrosis of the liver, and diffuse nephritis; exposure to 3200 ppm for 9 hours produced lung irritation and nephritis; death occurred after 1 to 5 days.

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

The former use of ethyl bromide as a human anesthetic produced respiratory irritation and caused some fatalities, either immediately, due to respiratory or cardiac arrest, or delayed, from effects on the liver, kidney, or heart. Relatively little experience with this substance in industry has been reported, but exposure of volunteers to 6500 ppm for 5 minutes produced vertigo, slight headache, and mild eye irritation. Irritation of the skin occurs from repeated contact with ethyl bromide liquid.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 109
2. Boiling point (760 mm Hg): 38.8 C (100 F)
3. Specific gravity (water = 1): 1.45
4. Vapor density (air = 1 at boiling point of ethyl bromide): 3.8
5. Melting point: -119 C (-182 F)
6. Vapor pressure at 20 C (68 F): 375 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.9
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with chemically active metals such as sodium, potassium, calcium, powdered aluminum, zinc, and magnesium may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving ethyl bromide. Ethyl bromide readily decomposes into hydrogen bromide and bromine particularly in the presence of hot surfaces.

4. Special precautions: Liquid ethyl bromide will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: Less than -20 C (less than -4F) (closed cup)
2. Autoignition temperature: 511 C (952 F)
3. Flammable limits in air, % by volume: Lower: 6.7; Upper: 11.3
4. Extinguishant: Foam, carbon dioxide, dry chemical

• Warning properties

Since the AIHA *Hygienic Guide* states that the odor of ethyl bromide is detectable only at concentrations well above the permissible exposure, it has been treated as a substance with poor warning properties. In addition, the *Hygienic Guide* reports a situation in which only mild eye irritation was produced in a human subject after a 5-minute exposure to 6500 ppm, a concentration many times greater than the permissible exposure. Information on the eye irritation threshold is not available.

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

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

- Any clothing which becomes wet with liquid ethyl bromide should be removed immediately and not reworn until the ethyl bromide is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid ethyl bromide may contact the eyes.

SANITATION

- Skin that becomes wet with liquid ethyl bromide should be promptly washed or showered with soap or mild detergent and water to remove any ethyl bromide.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as an alkylating or ethylating agent in manufacture of pharmaceuticals, and to a lesser extent, chemicals, dyes, and perfumes	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a solvent for fats, waxes, and resins	Process enclosure; if possible, local exhaust ventilation; personal protective equipment
Use as a local surface anesthetic for minor surgery and neuralgic pain	General dilution ventilation
Use as a liquid fumigant for grain and fruit	General dilution ventilation; personal protective equipment
Liberation during use as a refrigerant	Process enclosure; general dilution ventilation

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 ethyl bromide 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 ethyl bromide gets on the skin, promptly flush the contaminated skin using soap or mild detergent and water. If ethyl bromide soaks through the clothing, remove the clothing promptly and flush 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 ethyl bromide, 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 ethyl bromide 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 ethyl bromide is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Ethyl bromide should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

Sewers designed to preclude the formation of explosive concentrations of ethyl bromide vapors are permitted.

• Waste disposal method:

Ethyl bromide may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Ethyl Bromide," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Ethyl Bromide," *Hygienic Guide Series*, Detroit, Michigan, 1965.

- Dow Chemical Company: *Material Safety Data Sheet - Ethyl Bromide*, Midland, Michigan.
- International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1971.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- von Oettingen, W. F.: *The Halogenated Aliphatic, Olefinic, Cyclic, Aromatic, and Aliphatic-Aromatic Hydrocarbons Including the Halogenated Insecticides, Their Toxicity and Potential Dangers*, U.S. Public Health Service Publication No. 414, U.S. Government Printing Office, Washington, D.C., 1955.

RESPIRATORY PROTECTION FOR ETHYL BROMIDE

Condition	Minimum Respiratory Protection* Required Above 200 ppm
Vapor Concentration 2000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
3500 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 or continuous-flow mode.
Greater than 3500 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.