

Occupational Health Guideline for Ethylene Dibromide *

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: $\text{CH}_2\text{BrCH}_2\text{Br}$
- Synonyms: 1,2-Dibromoethane; ethylene bromide
- Appearance and odor: Colorless liquid or solid with a mild, sweet odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethylene dibromide is 20 parts of ethylene dibromide per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 30 ppm and a maximum peak of 50 ppm for 5 minutes during an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling level of 1 mg/m³ (0.13 ppm) averaged over a 15-minute period. The NIOSH Criteria Document for Ethylene Dibromide should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Ethylene dibromide 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:* Ethylene dibromide may cause vomiting, irritation of the eyes, nose, throat, and skin. It may also cause drowsiness. In addition, overexposure may cause damage to the lungs, liver, and kidneys.
2. *Long-term Exposure:* Prolonged or repeated exposure to ethylene dibromide may cause injury to the lungs,

liver, or kidneys. Adverse effects, including abnormalities in offspring, mutations, and stomach cancer, have been found in animals following exposure to ethylene dibromide. The relevance to humans of these findings has not yet been established.

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 ethylene dibromide.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to ethylene dibromide 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 nervous and respiratory systems, heart, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—14" x 17" chest roentgenogram: Ethylene dibromide causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Ethylene dibromide is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

—Liver function tests: Ethylene dibromide may cause liver damage. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

—Kidney disease: Although ethylene dibromide 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.

—Cardiovascular disease: Persons with cardiac disease may be at increased risk. An electrocardiogram should be performed on workers over 40 years of age and where indicated.

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

—Medical warning: Workers should be informed that adverse effects have been found in animals following exposure to ethylene dibromide. These effects have included abnormalities in offspring, mutations, and stomach cancer.

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

• **Summary of toxicology**

Ethylene dibromide vapor is a narcotic, a severe mucous membrane irritant, and a hepatic toxin. Rats did not survive when exposed to the vapor for longer than 6 minutes at 3000 ppm; minimum lethal concentration for an 8-hour exposure was 200 ppm; these exposures caused hepatic necrosis, pulmonary edema, and cloudy swelling of renal tubules. Four species of animals tolerated daily inhalation of 25 ppm for 6 months without adverse effects but did not tolerate similar exposure to 50 ppm. Accidental use as a human anesthetic resulted in severe irritation of the conjunctiva and respiratory tract, followed by protracted vomiting and death. Excessive exposure may be expected to cause irritation of the eyes and respiratory tract. The liquid is highly irritating to human skin, causing marked erythema and vesiculation. Serious skin injury has been reported from contact with clothing and especially shoes wet with ethylene dibromide. In a bioassay conducted by the National Cancer Institute (NCI), ethylene dibromide was found carcinogenic to rats and mice when fed by gavage. The compound induced squamous cell carcinomas of the fore stomach in rats of both sexes, hepatocellular carcinomas in female rats, and hemangiosarcomas in male rats. In mice of both sexes, the compound induced squamous cell carcinomas of the fore stomach and alveolar/broncheolar adenomas. In NIOSH-sponsored research, laboratory rats exposed to 20 ppm ethylene dibromide by inhalation and also receiving a diet containing 0.05% disulfiram experienced exceedingly high mortality levels as well as a high incidence of tumors (including hemangiosarcomas of the liver, spleen, and kidney).

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 187.9
2. Boiling point (760 mm Hg): 131 C (268 F)
3. Specific gravity (water = 1): 2.18
4. Vapor density (air = 1 at boiling point of ethylene dibromide): 6.5
5. Melting point: 10 C (50 F)
6. Vapor pressure at 20 C (68 F): 11 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.4
8. Evaporation rate (butyl acetate = 1): Data not

available

• **Reactivity**

1. Conditions contributing to instability: Heat; ethylene dibromide slowly decomposes in the presence of light.

2. Incompatibilities: Ethylene dibromide reacts with chemically active metals such as sodium, potassium, calcium, powdered aluminum, zinc, magnesium, liquid ammonia, and strong oxidizers.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen bromide, bromine, and carbon monoxide) may be released when ethylene dibromide decomposes.

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

• **Flammability**

1. Not combustible

• **Warning properties**

According to the International Labour Office (ILO), the odor of ethylene dibromide is detectable at 10 ppm, well above the NIOSH recommended permissible exposure concentration. Therefore, it is treated as a material with poor warning properties.

Ethylene dibromide is an eye irritant, according to Stecher.

MONITORING AND MEASUREMENT PROCEDURES

• **Eight-Hour Exposure Evaluation**

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).

• **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of ethylene dibromide. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Peak Level Evaluation**

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of ethylene dibromide. Each measurement should consist of a 5-minute sample or a series of consecutive samples totalling 5 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift

and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of ethylene dibromide 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 ethylene dibromide may be used. An analytical method for ethylene dibromide 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 ethylene dibromide.

- Non-impervious clothing which becomes contaminated with liquid ethylene dibromide should be removed immediately and not reworn until the ethylene dibromide is removed from the clothing.

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

- Where exposure of an employee's body to liquid ethylene dibromide may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

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

SANITATION

- Skin that becomes contaminated with ethylene dibromide should be immediately washed or showered with soap or mild detergent and water to remove any ethylene dibromide.

- Employees who handle ethylene dibromide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

- Eating and smoking should not be permitted in areas where ethylene dibromide is handled, processed, or stored.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in fumigation operations in preplanting and on grains, fruits, and vegetables	Local exhaust ventilation; general mechanical ventilation; personal protective equipment
Use in production of antiknock fluids and fuels	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in production of water-proofing agents fire extinguishing agents, and gauge fluids during manufacture of measuring instruments	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in organic synthesis in production of dyes, pharmaceuticals, and ethylene oxide; use as a specialty solvent for resins, gums, and waxes	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Operation

Liberation during production and handling of fumigant preparations

Controls

Local exhaust ventilation; general mechanical 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 ethylene dibromide gets 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 ethylene dibromide gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If ethylene dibromide soaks through the clothing, remove the clothing immediately 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 ethylene dibromide, 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 ethylene dibromide 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 ethylene dibromide is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.

2. If in the liquid form, collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

3. If in the solid form, collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Liquids containing ethylene dibromide should be absorbed in vermiculite, dry sand, earth, or a similar material.

• Waste disposal methods:

Ethylene dibromide may be disposed of:

1. If in the liquid form, by absorbing it in vermiculite, dry sand, earth, or a similar material and disposing in a secured sanitary landfill.

2. If in the solid form, by disposing in a secured sanitary landfill.

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 15, 1977.

RESPIRATORY PROTECTION FOR ETHYLENE DIBROMIDE

Condition	Minimum Respiratory Protection* Required Above 20 ppm
Vapor Concentration	
400 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.
Greater than 400 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.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of ethylene dibromide; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 400 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.