

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** ETHYLENE DIBROMIDE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYLENE DIBROMIDE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance ETHYLENE DIBROMIDE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions.

(1) "Permissible exposure" means inhalation of ethylene dibromide in concentrations not in excess of 20 parts per million (ppm) averaged over an eight-hour work shift and not in excess of 30 parts per million (ppm) at any time during an eight-hour work shift except that an exposure not in excess of 50 parts per million (ppm) at any aggregated of 5 minutes in any 3 hours shall be permitted as stated in §§ 1910.93, Table G-2.

(2) "Action level" means one half of the time averaged permissible exposure for ethylene dibromide for an eight-hour work shift.

(b) Exposure determination and measurement.

(1) Each employer who has a place of employment in which ethylene dibromide is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of ethylene dibromide at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of ethylene dibromide.

(2) A written record of the determination shall be made and it shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to ethylene dibromide;

(ii) Any measurements of ethylene dibromide taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethylene dibromide; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to ethylene dibromide at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b)(3) of this section reveals employee exposure to ethylene dibromide at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to ethylene dibromide at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to ethylene dibromide above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (e) of this section.

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to ethylene dibromide above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

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(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to ethylene dibromide below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement.

(1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over the time periods appropriate to the permissible exposure (See Appendix B (iv) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	$\pm 25\%$
At or below permissible exposure and above the action level	$\pm 35\%$
At or below the action level	$\pm 50\%$

(d) Compliance. (1) No employee shall be exposed to ethylene dibromide above the permissible exposure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of ethylene dibromide shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d) (4) of this section.

(3) Engineering controls: When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of ethylene dibromide.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

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- (ii) In work situations in which engineering and work practice controls are technically not feasible; or
 - (iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of ethylene dibromide to at or below the permissible exposure; or
 - (iv) For operations which require entry into tanks or closed vessels; or
 - (v) In emergencies.
- (5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR ETHYLENE DIBROMIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
400 ppm or less	A chemical cartridge respirator with a full facepiece and 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. (Supplied-air suits may be necessary.)
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

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Escape

Any gas mask providing protection
against organic vapors.

Any escape self-contained breathing
apparatus.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for ethylene dibromide.

(2) Ethylene dibromide shall be stored so as not to come in contact with chemically active metals.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees 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. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that non-impervious clothing which becomes contaminated with liquid ethylene dibromide be removed immediately and not reworn until the ethylene dibromide is removed from the clothing.

(3) Employers shall ensure that clothing contaminated with liquid ethylene dibromide is placed in closed containers for storage until it can be discarded or until the employer provides 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 employer shall inform the person performing the operation of the hazardous properties of ethylene dibromide.

(4) Where exposure of an employee's body to liquid ethylene dibromide may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(5) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133(a)(2)-(a)(6) where liquid ethylene dibromide may contact the eyes.

(g) Spills and disposal. In the event that liquid ethylene dibromide is spilled the employer shall immediately provide available ventilation and then clean up the spill.

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with ethylene dibromide immediately wash or shower using soap or mild detergent and water to remove any ethylene dibromide from the skin.

(2) Employers shall ensure that employees who handle ethylene dibromide wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(3) Employers shall ensure that employees do not eat or smoke in areas where ethylene dibromide is handled, processed or stored.

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(i) Training and information. (1) Each employer who has a workplace in which ethylene dibromide is present shall keep a copy of this regulation with Appendices A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to ethylene dibromide above the action level, or employees who may have skin or eye contact with liquid ethylene dibromide, or employees who work where accidental release or spill of ethylene dibromide may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for ethylene dibromide, (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to ethylene dibromide;

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to ethylene dibromide which are listed in Appendix A of this section;

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ethylene dibromide.

(j) Medical Surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall make available to each employee who is to be exposed to liquid ethylene dibromide or airborne concentrations of ethylene dibromide at or above the action level, without regard to the use of respirators, a medical examination which shall include as a minimum the following:

(i) A medical history and physical examination with emphasis on the lungs, liver and kidneys.

(3) The employer shall obtain from the physician, as a record of the examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(4) The employer shall make available to each employee, exposed to ethylene dibromide in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in excess of the action level thereafter, a medical examination which must include the following:

(i) A medical history and physical examination (see paragraph (j)(2)(i) of this section).

(5) The employer shall obtain from the physician, as a record of the periodic examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(6) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with its Appendices A, B, and C;

(ii) A description of the employee's duties as they relate to his exposure to ethylene dibromide;

(iii) A description of any personal protective equipment, including respirators, required to be used;

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(iv) The results of any employee's exposure measurement, if available;
(v) The employee's anticipated exposure level; and
(vi) Upon request of the physician, information from previous medical examination of the employee.

(7)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical conditions which could be directly or indirectly aggravated by exposure to ethylene dibromide or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The written opinion shall not reveal medical information unrelated to exposure to ethylene dibromide.

(8) No employee shall be exposed to ethylene dibromide if such exposure could place the employee at increased risk of material impairment of his health. This determination may be based on the physician's written opinion.

(9) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to ethylene dibromide.

(10) If the examining physician chooses to use alternative medical examinations to those specified in paragraphs (j)(2) and (4) of this section, the employer may accept such alternative medical surveillance examinations as meeting the requirements of this part provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical examinations and the rationale for substitution and evidence that they will be equally effective.

(ii) Informs each exposed employee of the fact that alternative medical examinations to those required in paragraphs (j)(2) or (4) of this section are to be made available.

(11) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risks involved by refusing to be examined.

(12) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination.

(i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to ethylene dibromide.

(ii) This record shall include:

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- (A) The date of measurement;
- (B) Operations involving exposure to ethylene dibromide which are being monitored;
- (C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;
- (D) Number, duration, and results of samples taken; and
- (E) Name, social security number and exposure of the employee monitored.
- (iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.
- (3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.
- (ii) This record shall include:
 - (A) Date of measurement;
 - (B) Type of measurement taken;
 - (C) Result of measurement.
- (iii) These records shall be maintained for at least one year.
- (4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.
- (ii) This record shall include:
 - (A) Date of training;
 - (B) Name and social security number of employee trained;
 - (C) Content or scope of training provided.
- (iii) This record shall be maintained until replaced by a more recent record.
- (5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.
- (ii) This record shall include:
 - (A) Results of tests required by paragraph (j)(2) and (j)(5) of this section;
 - (B) Any employee medical complaints relative to exposure to ethylene dibromide;
 - (C) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section.
 - (D) Physician's written opinion; and
 - (E) A signed statement of any refusal to be examined.
- (iii) This record shall be maintained for the duration of the employment of the affected employee.
- (6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.
- (ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

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(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to ethylene dibromide which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to ethylene dibromide requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

- (i) Receive an explanation of the measurement procedure.
- (ii) Visually observe all steps related to the measurement of the airborne concentration of ethylene dibromide that are being performed at the place of exposure; and
- (iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR ETHYLENE DIBROMIDE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Ethylene dibromide
- B. Permissible Exposure: Eight-hour average concentration is 20 parts of ethylene dibromide per million parts of air (ppm). Also 30 ppm must not be exceeded, except that concentrations up to 50 ppm are permitted for as long as five minutes if no other exposure occurs during an eight-hour shift.
- C. Appearance and Odor: Colorless liquid or solid with a mild, sweet odor.

— II. HEALTH HAZARD DATA

- A. Ways in Which the Chemical Affects Your Body: Ethylene dibromide can affect your body if you inhale it or if it comes in contact with your eyes and skin or if you swallow it. It may be absorbed through the skin.

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B. 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.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to ethylene dibromide.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If ethylene dibromide gets into your eyes, wash your 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.
- B. Skin Exposure: If ethylene dibromide gets on your skin, immediately wash the contaminated skin using soap or mild detergent and water. If ethylene dibromide soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.
- C. Breathing: If you or any other 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.
- D. Swallowing: When ethylene dibromide has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.
- E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to ethylene dibromide. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required

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to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell ethylene dibromide while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with ethylene dibromide liquid. Replace or repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear splash-proof safety goggles (cup - cover type dust and splash safety goggles) where eye contact to liquid ethylene dibromide may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. It must be stored in tightly closed containers away from chemically active metals, liquid ammonia, and strong oxidizers.

B. If your skin becomes contaminated with ethylene dibromide, you must immediately wash or shower using mild soap or detergent and water to remove any ethylene dibromide from the skin.

C. You must immediately remove any non-impervious clothing that becomes contaminated with ethylene dibromide and this clothing must not be reworn until the ethylene dibromide is removed from the clothing.

D. You must not eat or smoke in areas where ethylene dibromide is handled, processed or stored.

E. If you handle ethylene dibromide, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

F. Quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.

G. Ask your supervisor where ethylene dibromide is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for ethylene dibromide and to instruct you in the safe and correct use of protective equipment.

B. Your employer is required to determine whether you are being overexposed to ethylene dibromide. You or your representative has the right to observe employee exposure measurements and to be informed of the results.

C. Your employer is required to release your exposure determination and medical records to your physician upon written request from your physician.

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SUBSTANCE TECHNICAL GUIDELINES
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- I. PHYSICAL AND CHEMICAL DATA
 - A. Substance Identification
 - 1. Synonyms: 1,2-dibromoethane; ethylene bromide
 - 2. Formula: $\text{CH}_2\text{BrCH}_2\text{Br}$
 - 3. Molecular weight: 187.9
 - B. Physical Data
 - 1. Boiling point (760 mm Hg): 131 C (268 F)
 - 2. Specific gravity (water=1): 2.18
 - 3. Vapor density (air=1 at boiling point of ethylene dibromide): 6.5
 - 4. Melting point: 10 C (50 F)
 - 5. Vapor pressure at 20 C (68 F): 11 mm Hg
 - 6. Solubility in water, % by weight at 20 C (68 F): 0.4
 - 7. Evaporation rate (butyl acetate=1): data not available
 - 8. Appearance and odor: Colorless liquid or solid with a mild sweet odor.
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
 - A. Fire
 - 1. Not combustible
 - B. Reactivity
 - 1. Conditions contributing to instability: Heat; ethylene dibromide slowly decomposes in the presence of light
 - 2. Incompatibilities: Reacts with chemically active metals, such as sodium, potassium, calcium, powdered aluminum, zinc magnesium, liquid ammonia, and strong oxidizers. 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.
- III. SPILL, LEAK AND DISPOSAL PROCEDURES
 - A. If ethylene dibromide is spilled or leaked, the following steps should be taken:
 - 1. Ventilate area of spill or leak.
 - 2. If in liquid form collect for reclamation or absorb in vermiculite, dry sand, earth or similar material.
 - 3. If in 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 similar material.
 - B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
 - C. Waste disposal methods:
 - Ethylene dibromide may be disposed of:
 - 1. If in liquid form, by absorbing it in vermiculite, dry sand, earth or similar material and disposing in a secured sanitary landfill.

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

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL

1. Eight hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average eight-hour exposure may be determined from a single 8-hour sample or two (2) four-hour samples. Several short term samples (up to 30 minutes) may also be used to determine 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).
2. Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of ethylene dibromide in the employee's breathing zone. 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.
3. Peak Above Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentration of ethylene dibromide. Each measurement should consist of a 5-minute sample or series of consecutive samples totaling five (5) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurement should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.
4. Monitoring Techniques: The sampling and analyses under this section may be performed by instruments such as: detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of ethylene dibromide to plus or minus 35%.

- B. Exposure above the permissible exposure: The monitoring under this section should be essentially the same as described under paragraph (IV)(A). When sampling for peak exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of ethylene dibromide to plus or minus 25%.

- C. Methods meeting these accuracy requirements are available from NIOSH.

- D. Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures,

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employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store ethylene dibromide in tightly closed containers in a cool, well-ventilated area.
- B. Employers should advise employees of all areas and operations where exposure to ethylene dibromide could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to ethylene dibromide is likely to occur are: during its use as a fumigant for fruits, vegetables, grains and soils; as a solvent for gums and waxes; as a component of water-proofing and fire-extinguishing agents; as a component of fluid antiknock compounds in gasoline, as a chemical intermediate in the production of dyes, pharmaceuticals and ethylene oxide; and during its production.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. 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 3,000 ppm; minimum lethal concentration for 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 occasional cardiac failure. There have been no reported human injuries due to inhalation of vapor in industry, although 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. One report indicates a high incidence of gastric squamous cell carcinoma of the stomach in rats and mice after administration of the substance in the diet or by gavage.

III. SIGNS AND SYMPTOMS

Respiratory irritation; eye irritation; severe dermatitis with vesiculation.

—IV. SPECIAL TESTS

Urinary bromides might indicate exposure.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap and water. If swallowed and the person is conscious, induce vomiting. Give

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artificial resuscitation if indicated. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Ethylene dibromide is highly toxic. Overexposure may cause severe gastrointestinal symptoms and pulmonary damages. Skin absorption occurs. Recent reports indicate that ethylene dibromide could be associated with increased incidence of stomach cancer. It is important that the physician becomes familiar with plant operating conditions in which exposure to ethylene dibromide occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators. The liquid penetrates leather, as well as several types of protective clothing, particularly neoprene rubber and some plastic gloves.

B. PREPLACEMENT

The following medical procedures must be made available to each employee who is exposed to ethylene dibromide:

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

C. PERIODIC EXAMINATION

The above medical examinations are to be repeated on an annual basis.

REFERENCES

1. American Conference of Governmental Industrial Hygienists: "1,2-Dibromomethane - Skin." Documentation of the Threshold Limit Values for Substances in Workroom Air (3D Ed., 2D Printing), Cincinnati, 1974, pp. 309-310.
2. Hygienic Guide Series: "Ethylene Dibromide," American Industrial Hygiene Association Journal, 19:156-157, 1958.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2D Ed. Revised), Interscience Publishing Company, New York, 1963, pp. 1284-1287.
4. Von Oettingen, W.F.: The Halogenated Aliphatic, Olefinic, Cyclic, Aromatic, and Aliphatic-Aromatic Hydrocarbons Including the Halogenated

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Insecticides, Their Toxicity and Potential Dangers, U.S. Public Health Service Publication No. 414, U.S. Government Printing Office, Washington, D.C., 1955, pp. 149-153.

5. Rowe, V.K., et al.: "Toxicity of Ethylene Dibromide Determined in Experimental Animals," A.M.A. Archives of Industrial Hygiene and Occupational Medicine, 6:158-173, 1952.

6. Powers, M.B., et al: "Carcinogenicity of Ethylene Dibromide (EDB) and 1,2-Dibromo-3-Chloropropane (DBCP) After Oral Administration in Rats and Mice." Paper presented at 14th annual meeting of Society of Toxicology, Williamsburg, Virginia, March 9-13, 1975.

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REFERENCES AND SOURCES
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- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Patty, "Industrial Hygiene and Toxicology," Commonwealth of Pennsylvania"; Hygienic Information Guide No. 69, "Ethylene Dibromide"; Grant, "Toxicology of the Eye"
Skin: Patty, "Industrial Hygiene and Toxicology"; Sax, "Dangerous Properties of Industrial Materials"; and AIHA Hyg. Guide
Ingestion: American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values"; Patty, "Industrial Hygiene and Toxicology"; Sax, "Dangerous Properties of Industrial Materials"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

In experiments on rabbits, "undiluted material caused obvious pain and conjunctival irritation," according to Patty; although a slight but superficial necrosis of the cornea was observed, healing occurred promptly and was complete. The Penn. Guide Series note that it will cause severe burns when in contact with the eye. Grant states that "testing by applying a drop to a rabbit's eye has caused only transient corneal epithelial damage." Since Patty and Grant refer to experimental studies, it is concluded that any injury caused is transitory and it is assumed that irritation caused is moderate in degree.

Skin - Classification: 2

Output statement numbers: 2, 7a, 8b, 14g, 14i, 20a

Exceptions: 8b added; 14 substituted for 16 or 17

Patty states that investigations show that

"ethylene dibromide could be readily absorbed through the skin in toxic amounts; a dose of .21 g/kg to rabbit skin for 24 hours killed one of 15 animals while a dose of 1.1 g/kg killed all in a group of five test animals." A one percent solution caused erythema and exfoliation when repeatedly applied to rabbit ears and a reaction leading to "necrosis and sloughing of the superficial layers of the skin" when bandaged to the animals' shaved abdomen.

A case of prolonged contact, confined in shoes, was observed to result in reddening, blistering and burning pain. Sax rates it as a highly toxic local irritant in acute exposures and a moderately toxic local irritant in chronic exposures. Systemically, it is listed as a moderately toxic compound for chronic exposures. Vapor pressure of the material is 11 mm Hg at 20 C. The substance is not combustible.

Because of the skin absorption hazards of the material, statements 8b and 14 are used even though the classification given is 2.

Ingestion - Classification: 1

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Output statement numbers: 19, 20a

Exceptions: None

A human fatality following ingestion of 4.5 ml of ethylene dibromide is reported in the Documentation of TLV's. The oral LD50 for male rats is 0.148 g/kg, according to Patty. The LD50 for female rabbits is given as 0.055 g/kg. Sax rates ethylene dibromide as highly toxic locally and systemically in acute exposures and moderately toxic systemically in chronic exposures. The toxicity of this liquid is concluded to be high enough to warrant assignment of a hazard classification of 1.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)
Ethyl Corp., Material Safety Data Sheet (Ethyl)
Dow Chemical USA, "Dow Products and Services" (Dow)
Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 3, p. 771 (K-O)

Sources of data items used:

- I. A. 1. Synonyms: NFPA-49; Ethyl
2. Formula: NFPA-49
3. Molecular weight: ADL
- B. 1. Boiling point: NFPA-49; Ethyl; Dow
2. Specific gravity: NFPA-49; Dow
3. Vapor density: Ethyl
4. Melting point: NFPA-49; Dow
5. Vapor pressure: Ethyl
6. Solubility in water: Ethyl; K-O
7. Evaporation rate: data not available
8. Appearance and odor: Ethyl; K-O
- II. B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: Ethyl; ADL
3. Hazardous decomposition products: NFPA-49; Ethyl
4. Special precautions: ADL
- III. A. Steps if released or spilled: Ethyl; ADL
C. Waste disposal method: Ethyl
- V. Miscellaneous precautions: Ethyl

USE/EXPOSURE AND CONTROL DOCUMENT

Sources used in the preparation of this document include:

"Ethylene Dibromide," American Conference of Government Industrial Hygienists, Hygienic Guide Series, April 1958 (Hygienic Guides)
"Ethylene Dibromide," Hygienic Information Guide No. 69, Commonwealth of Pennsylvania Department of Health, Division of Occupational Health, June 1968 (Penn)
International Labour Organization, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)
Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 2nd edition, 1972 (K-O)
Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)
Plunkett, E. R., "Handbook of Industrial Toxicology," Chemical Publishing

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Co., Inc., 1966 (Plunkett)

Rowe, V. K., Spencer, H. C., McCollister, D. D., Hollingsworth, R. L. and Adams, E. M., "Toxicity of Ethylene Dibromide Determined on Experimental Animals," Archives of Industrial Hygiene and Occupational Medicine, 6:158 - 173, 1952 (Rowe)

Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)

U. S. Environmental Protection Agency, "EPA Compendium of Registered Pesticides," Vol. II, U. S. Government Printing Office, Washington, D. C. (EPA)

References for Specific Use/Exposure

1. ILO, EPA
2. K-O, SRI
3. ILO
4. EPA, Patty, ADL estimate
5. Plunkett, Hygienic Guides
6. Plunkett, Patty, ILO
7. Patty, ILO, Rowe
8. SRI, K-O
9. SRI, K-O, Rowe

References for Specific Control Methods

Rowe, Hygienic Guides and Penn. were the references used for the Specific Control Methods in numbers 1 - 9.

RESPIRATOR JUSTIFICATION TABLE

Patty reports that central nervous system depression results from exposures to high concentrations of ethylene dibromide, but the anesthesia produced is only slight. Acute exposures cause damage to the lungs, liver, and kidneys.

Patty reports that in an acute vapor exposure study using rats, the "maximum survival exposures" were 3000 ppm for 6 minutes, 400 ppm for 30 minutes, and 200 ppm for 2 hours. For guinea pigs the "maximum survival exposures" were 400 ppm for 2 hours and 200 ppm for 7 hours.

Spector gives several LC100 concentrations for rats: 400 ppm for 300 minutes, 1600 ppm for 30 minutes, 5000 ppm for 8.4 minutes, and 10,000 ppm for 6 minutes. An LC100 of 400 ppm was determined for guinea pigs exposed to ethylene dibromide for 420 minutes.

The Documentation of TLV's state that for an 8-hour exposure to ethylene dibromide the minimum lethal concentration for rats was determined to be 200 ppm. The Documentation also notes that "Vapor concentrations which are anesthetic are highly irritating to the mucous membranes."

The LC50 concentration given in the NIOSH Toxic Substances List for rats for a 1-hour exposure is 689 ppm; for rabbits for a 1-hour exposure is 6425 ppm; and for guinea pigs for a 3-hour exposure is 390 ppm.

The AIHA Hygienic Guides do not give an IDLH concentration for ethylene dibromide.

Ethylene dibromide is readily absorbed through the intact skin. Spector gives a LD100 of ethylene dibromide by skin absorption in the rabbit of 1.1 g/kg for a 24-hour exposure, and a LD40 of .3 g/kg.

WARNING PROPERTIES: According to the ILO, the odor of ethylene dibromide is detectable at 10 ppm, well below its

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permissible exposure concentration. Ethylene dibromide is treated as a material with adequate warning properties.

EYE IRRITATION: Ethylene dibromide is an eye irritant, according to Stecher.

IDLH: Based upon the maximum survival exposure of 400 ppm for 30 minutes for rats reported by Patty, an IDLH of 400 ppm is assumed for the purposes of this standard.

LFL: Ethylene dibromide is nonflammable.

PERMISSIBLE EXPOSURE: 20 ppm.

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and contact with liquid during fumigation operations (preplanting fumigation of soil and fumigation of commodities such as grains, fruits, and vegetables)	A,B,D	Local exhaust ventilation; general mechanical ventilation; personal protective equipment (gloves, goggles, protective clothing, respiratory protective devices)
2.	Inhalation of vapor and skin contact with liquid during production and handling of anti-knock fluids and fuels containing anti-knock fluids	A,B,D	Local exhaust ventilation; general mechanical ventilation; personal protective equipment (gloves, goggles, protective clothing)
3.	Inhalation of vapor and skin contact with liquid during production and handling of ethylene dibromide	A,BD	Local exhaust ventilation; general mechanical ventilation; personal protective equipment (gloves, goggles, protective clothing)
4.	Inhalation of vapor and skin contact with liquid during production and handling of fumigant preparations	A,B,D	Local exhaust ventilation; general mechanical ventilation; personal protective equipment (gloves, goggles, protective clothing)
5.	Inhalation of vapor and skin contact with liquid during production and application waterproofing agents	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective clothing, respiratory protective devices)
6.	Inhalation of vapor and skin contact with liquid during production and use of fire extinguishing agents	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective clothing, respiratory protective devices)
7.	Inhalation of vapor and skin contact with liquid during production and handling of gauge fluids during manufacture of	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective

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measurement instruments

clothing)

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| 8. | Inhalation of vapor and skin contact with liquid during organic synthesis (dyes, pharmaceuticals, ethylene oxide) | A,B,D | Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective clothing) |
| 9. | Inhalation of vapor and skin contact with liquid during use as a specialty solvent (resins, gums, waxes) | A,B,D | Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective clothing) |

- A -- Inhalation
- B -- Skin contact resulting in localized irritation
- C -- Ingestion
- D -- Skin contact resulting in absorption and subsequent systemic poisoning