

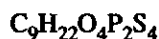
OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ETHION

INTRODUCTION

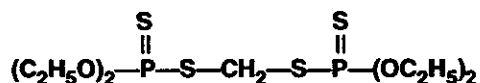
This guideline summarizes pertinent information about ethion for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

• Formula



• Structure



• Synonyms

bis(S-(Diethoxyphosphinothiyl)mercapto)methane; ethyl methylene phosphorodithioate; O,O,O',O'-tetraethyl S,S'-methylene di(phosphorodithioate); phosphorodithioic acid, O,O-diethyl ester, S,S-diester with methanedithiol; Bladan; Diethion; Embathion; Ethanox; Ethodan; Fosfono 50; Hylemox; Niagra 1240; Nialate; Rhodiocide; Rhodocide; Soprathion

• Identifiers

1. CAS No.: 563-12-2
2. RTECS No.: TE4550000
3. DOT NA: 2783 55
4. DOT label: Poison

• Appearance and odor

Ethion is a colorless liquid that is odorless when pure. Ethion is marketed in several forms: as granules, a wettable powder, a dust, and in various oil solutions and combinations with other materials. Technical grade ethion has a very disagreeable odor.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 384.48
2. Boiling point (760 mm Hg): Decomposes above 150°C (302°F)
3. Specific gravity (water = 1): 1.22 at 20°C (68°F)
4. Vapor density: Data not available
5. Freezing/melting point: -12° to -13°C (8.6° to 10.4°F)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Education and Information Division

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

6. Vapor pressure at 25°C (77°F): 0.0000015 mm Hg
7. Solubility: Slightly soluble in water; soluble in acetone, methyl alcohol, ethyl alcohol, xylene, chloroform, methylated naphthalene, and petroleum oils.
8. Evaporation rate: Data not available

Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame
2. Incompatibilities: Ethion is incompatible with alkaline formulations.
3. Hazardous decomposition products: Toxic gases (such as oxides of sulfur and phosphorus) may be released in a fire involving ethion.
4. Special precautions: None reported

Flammability

The National Fire Protection Association has not assigned a fire hazard rating for ethion.

1. Flash point: 176°C (348.8°F)
2. Autoignition temperature: Data not available
3. Flammable limits: Data not available
4. Extinguishant: Use dry chemical, carbon dioxide, water spray, fog, or standard foam to fight fires involving ethion. If a leak or spill has not ignited, water spray may be used to disperse vapors and to protect persons attempting to stop the leak.

Fires involving ethion should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Containers of ethion may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Dikes should be used to contain fire-control water for later disposal. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving ethion. Chemical protective clothing that is specifically recommended for ethion may not provide thermal protection unless so stated by the clothing manufacturer.

Structural firefighters' protective clothing is not effective against fires involving ethion.

EXPOSURE LIMITS

• OSHA PEL

The Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure limit (PEL) for ethion [29 CFR 1910.1000, Table Z-1].

• NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 0.4 mg/m³ as a TWA for up to a 10-hr workday and a 40-hr workweek for ethion. The NIOSH REL also bears a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overall exposure [NIOSH 1992].

• ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned ethion a threshold limit value (TLV) of 0.4 mg/m³ as a TWA for a normal 8-hr workday and a 40-hr workweek. The ACGIH also assigns a "Skin" notation to ethion [ACGIH 1993].

• Rationale for limits

The NIOSH limit is based on the risk of cholinesterase inhibition and toxic effects on the nervous, respiratory, and digestive systems associated with ethion exposure [NIOSH 1992]. The ACGIH limit is based on the risk of organophosphate poisoning associated with exposure to ethion [ACGIH 1991].

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to ethion can occur through inhalation, ingestion, eye or skin contact, and absorption through the skin.

• Summary of toxicology

1. *Effects on Animals:* Ethion is an organophosphate pesticide that produces its effects by inhibiting cholinesterase activity in the central nervous system.

Instilled into the eyes of rabbits, 0.05 ml of ethion caused immediate irritation without corneal injury [NLM 1993]. The dermal LD₅₀ is 62 mg/kg in rats and 915 mg/kg in guinea pigs [NIOSH 1993]. The LC₅₀ in rats is 864 mg/m³ for an unspecified period [NIOSH 1993]. The oral LD₅₀ is 13 mg/kg in rats and 40 mg/kg in mice [NIOSH 1993]. Rats fed ethion at a dietary level of 300 ppm for 28 days developed marked cholinesterase inhibition, and those fed dietary levels of 600 to 1,500 ppm showed complete cholinesterase inhibition [NLM 1993].

2. **Effects on Humans:** Ethion is an organophosphate pesticide that causes cholinesterase inhibition in humans. The lethal oral dose in humans is estimated to be 50 to 500 mg/kg [Gosselin et al. 1984]. Ethion is reported to have caused organophosphate poisoning in peach and grape pickers who were applying this pesticide [ACGIH 1991]. In an in vitro culture, ethion caused a significant increase in the frequency of sister chromatid exchanges in human lymphoid cells [NLM 1993].

• **Signs and symptoms of exposure**

1. **Acute exposure:** Acute oral exposure causes severe gastrointestinal effects, such as cramps, diarrhea, nausea, and anorexia. Acute inhalation causes wheezing, difficult breathing, blurred vision, constricted pupils, and tearing. Acute dermal exposure causes localized twitching and sweating. Severe overexposure by any route can cause respiratory paralysis, coma, and death.

2. **Chronic exposure:** Repeated exposure to small amounts of ethion may cause acetylcholine buildup and lead to the signs and symptoms of poisoning described above for acute exposure.

• **Emergency procedures:**

<p style="text-align: center;">WARNING!</p> <p style="text-align: center;">Exposed victims may die!</p> <p style="text-align: center;">Transport immediately to emergency medical facility!</p>
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Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. *Immediately* initiate the following emergency procedures, continuing them as appropriate en route to the emergency medical facility:

1. **Eye exposure:** *Immediately* rinse concentrated solutions, vapors, mists, or aerosols of ethion from the eyes with large amounts of water for at least 15 min, occasionally lifting the lower and upper eyelids. If irritation persists, get medical attention as soon as possible.

2. **Skin exposure:** Ethion can be absorbed through the skin in lethal amounts. *Immediately* remove all contaminated clothing and *thoroughly* wash contaminated skin with soap and water for at least 15 min.

3. **Inhalation exposure:** Move the victim to fresh air *immediately*. If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. **Ingestion exposure:** Take the following steps if ethion or a solution containing this substance is ingested:

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.

—Have the victim drink a glass (8 oz) of fluid such as water.

—Induce vomiting by having the victim touch the back of the throat with a finger until productive vomiting ceases. Do *not* give syrup of ipecac because of possible onset of respiratory depression and seizures.

—Do *not* force an unconscious or convulsing person to drink fluid or to vomit.

5. **Rescue:** Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve ethion and lead to worker exposures to this substance:

—Use as an insecticide and acaricide for citrus fruit, apples, nuts, deciduous fruit, and cotton

—Use as a cattle dip for ticks and as a treatment for buffalo flies

—Use for the control of aphids, mites, scales, thrips, leafhoppers, maggots, and foliar feeding larvae on a wide variety of food, fiber, and ornamental crops

The following methods are effective in controlling worker exposures to ethion, depending on the feasibility of implementation:

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information on control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. *Engineering design for control of workplace hazards*. New York, NY: McGraw-Hill.
5. Plog BA [1988]. *Fundamentals of industrial hygiene*. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for

diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

• Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to ethion, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on red blood cell and plasma cholinesterase activity.

A preplacement medical evaluation is recommended to assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to ethion at or below the prescribed exposure limit. The health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with reductions in red blood cell or plasma cholinesterase activity levels.

• Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to ethion exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of ethion on red blood cell or plasma cholinesterase activity. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. The measurement of red blood cell cholinesterase (RBC ChE) is a nonspecific qualitative indicator of exposure to organophosphorus chemicals such as ethion. Inhibition of RBC ChE can be an indicator either of acute overexposure or of cumulative chronic exposure, depending on the intensity and duration of exposure. Individual pre-exposure levels of enzyme activities should be determined by measuring RBC ChE activity in blood samples collected on two occasions (at least 3 days apart) before exposure begins or following at least 30 days without exposure; the same method and laboratory should be used for sampling and analysis. An RBC ChE activity level that is equal to 70 percent of the individual's baseline is recommended by some sources as a Biological Exposure Index (BEI) for exposure to organophosphorus chemicals.

- **Medical examinations recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

Determination of a worker's exposure to airborne ethion is made using an OSHA Versatile Sampler (OVS-2) with a 13-mm XAD-2 tube (270/140 mg sections, 20/60 mesh) with glass fiber filter enclosed. Samples are collected at a recommended flow rate of 1.0 liter/min until a recommended air volume of 480 liters is collected. The sample is then treated with toluene to extract the ethion. Analysis is conducted by gas chromatography using a flame photometric detector. This method is described in the OSHA Computerized Information System [OSHA 1993] and the *OSHA Chemical Information Manual* [OSHA 1987].

PERSONAL HYGIENE

Ethion can be absorbed through the skin in toxic amounts. Therefore, if ethion contacts the skin, workers should

wash the affected areas repeatedly and vigorously with soap and water.

Clothing contaminated with ethion should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of ethion, particularly its potential to be absorbed through the skin in toxic amounts.

A worker who handles ethion should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, or applying cosmetics.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where ethion or a solution containing ethion is handled, processed, or stored.

STORAGE

Ethion should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Containers of ethion should be protected from physical damage and should be stored separately from food or feed products, heat, sparks, and open flame. Because containers that formerly contained ethion may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving ethion, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material.
2. Notify safety personnel.
3. Remove all sources of heat and ignition.
4. Ventilate the area of the spill or leak.
5. For small dry spills, use a clean shovel and gently place the material into a clean, dry container, creating as little dust as possible; cover and remove the container from the spill area.

6. For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal.
7. For large liquid spills, build dikes far ahead of the spill to contain the ethion for later reclamation or disposal.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous waste, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

- **Emergency planning requirements**

The owners or operators of a facility must comply with EPA's emergency planning requirements [40 CFR 355.30] if 1,000 lb or more of ethion are present.

- **Reportable quantity requirements for hazardous releases**

A hazardous substance release is defined by EPA as any spilling, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of containers) of hazardous substances. In the event of a release that is above the reportable quantity for that chemical, employers are required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the proper Federal, State, and local authorities.

The reportable quantity for ethion is 10 lb. If an amount equal to or greater than this quantity is released within a 24-hr period in a manner that will expose persons outside the facility, employers are required to do the following:

- Notify the National Response Center *immediately* at (800) 424-8802 or at (202) 426-2675 in Washington, D.C. [40 CFR 302.6].
- Notify the emergency response commission of the State likely to be affected by the release [40 CFR 355.40].

—Notify the community emergency coordinator of the local emergency planning committee (or relevant local emergency response personnel) of any area likely to be affected by the release [40 CFR 355.40].

- **Community right-to-know requirements**

Employers are not required by Section 313 of the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022] to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of ethion emitted or released from their facility annually.

- **Hazardous waste management requirements**

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Although ethion is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

- **Conditions for respirator use**

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of ethion

exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only those respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

- **Respiratory protection program**

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information about the selection and use of respirators and about the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective gloves and clothing should be worn to prevent any skin contact with ethion. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. Teflon has been tested for use against permeation by ethion and may provide protection for periods greater than 4 but less than 8 hours. Natural rubber has a breakthrough time of less than 1 hr and is therefore not recommended for use against permeation by ethion.

If ethion is dissolved in water or an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or face shields should be worn during operations in which ethion might contact the eyes

(e.g., through splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with ethion.

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