

Occupational Health Guideline for Ethyl Chloride

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: C_2H_5Cl
- Synonyms: Chloroethane; monochloroethane; hydrochloric ether; muriatic ether
- Appearance and odor: Colorless liquid or gas with a pungent, ether-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethyl chloride is 1000 parts of ethyl chloride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 2600 milligrams of ethyl chloride per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Ethyl chloride can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. In the liquid form, it may be absorbed through the skin.

• Effects of overexposure

1. *Short-term Exposure:* Ethyl chloride may cause drowsiness, unconsciousness, irregular heart beat, and death. It may also cause irritation of the eyes and abdominal cramps. Spilled on the skin, it may cause frostbite.

2. *Long-term Exposure:* Ethyl chloride may cause liver and kidney damage.

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 ethyl chloride.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to ethyl chloride at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from ethyl chloride exposure.

—Liver disease: Ethyl chloride is known as a liver toxin in animals and justifies consideration before exposing persons with impaired liver function.

—Kidney disease: Ethyl chloride is known as a kidney toxin in animals and justifies special consideration before exposing persons with impaired renal function.

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

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

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

• Summary of toxicology

Ethyl chloride vapor is a narcotic. Guinea pigs died from a 9-hour exposure to 40,000 ppm but survived 4-½ hour exposure; histopathological changes in the lungs, liver, and kidneys were observed in animals in the latter group. Inhalation of 40,000 ppm by human subjects caused dizziness, eye irritation, and abdominal cramps, while inhalation of 3.36% by volume (33,600 ppm) caused a toxic effect after 30 seconds, increasing within 5 minutes to noisy talkativeness followed by incoordina-

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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tion. At 2.5% by volume (25,000 ppm) there was incoordination; 1.9% (19,000 ppm) caused weak analgesia after 12 minutes, and 1.3% (13,000 ppm) caused slight symptoms of inebriation. Sudden and unforeseen fatalities from ethyl chloride anesthesia have been reported, probably due to respiratory or cardiac arrest. Chronic effects from industrial exposure have not been reported, although skin absorption is said to occur. In liquid form this substance may cause frostbite.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 64.5
2. Boiling point (760 mm Hg): 12.2 C (54 F)
3. Specific gravity (water = 1): 0.92
4. Vapor density (air = 1 at boiling point of ethyl chloride): 2.2
5. Melting point: -139 C (-218 F)
6. Vapor pressure at 20 C (68 F): 1064 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.57
8. Evaporation rate (butyl acetate = 1): Much higher than 1

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with chemically active metals such as sodium, potassium, calcium, powdered aluminum, zinc, and magnesium may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving ethyl chloride.
4. Special precautions: Liquid ethyl chloride will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: -50 C (-58 F) (closed cup)
2. Autoignition temperature: 519 C (966 F)
3. Flammable limits in air, % by volume: Lower: 3.8; Upper: 15.4
4. Extinguishant: Stop flow of gas. Use carbon dioxide, dry chemical, or foam for small fires.

• Warning properties

Ethyl chloride has a somewhat pungent, ether-like odor, but no quantitative data are available on the odor threshold. For the purposes of this guideline, therefore, ethyl chloride has been treated as a material with poor warning properties.

Ethyl chloride is a mild eye irritant. Grant reports that at 4% the gas has been noted to cause slight irritation of the eyes of human beings.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based

on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

An analytical method for ethyl chloride is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid ethyl chloride.
- Clothing wet with liquid ethyl chloride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of ethyl chloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethyl chloride, the person performing the operation should be informed of ethyl chloride's hazardous properties.
- Any clothing which becomes wet with liquid ethyl chloride should be removed immediately and not worn until the ethyl chloride has evaporated.
- Employees should be provided with and required to use splash-proof safety goggles where liquid ethyl chloride may contact the eyes.

COMMON OPERATIONS AND CONTROLS

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

Operation

Use in production of tetraethyl lead and ethyl cellulose

Use as a local or general anesthetic; use as a refrigeration compound; use as a solvent for fats, oils, waxes, phosphorus, acetylene, and many resins

Use in organic synthesis of perchloroethane, esters, and Grignard reagents

Use in manufacture of dyes and drugs; use as a propellant in aerosols

Use in manufacture of perfumes

Controls

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

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Local exhaust ventilation

or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If ethyl chloride is spilled or leaked, the following steps should be taken:

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

• Waste disposal methods:

Ethyl chloride may be disposed of:

1. If in the liquid form, by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. If in the gaseous form, by burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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 liquid ethyl chloride 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 liquid ethyl chloride gets on the skin, promptly wash the contaminated skin with water if the ethyl chloride has not already evaporated. If liquid ethyl chloride soaks through the clothing, remove the clothing immediately and flush the skin with water. Do not use hot water for skin flushing. If irritation is present after washing, get medical attention.

• Breathing

If a person breathes in large amounts of ethyl chloride, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When ethyl chloride 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

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RESPIRATORY PROTECTION FOR ETHYL CHLORIDE

Condition	Minimum Respiratory Protection* Required Above 1000 ppm
Vapor Concentration 10,000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
20,000 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator with a half facepiece operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 20,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.