

# Occupational Health Guideline for Ethylene Chlorohydrin

## 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:  $\text{CH}_2\text{ClCH}_2\text{OH}$
- Synonyms: 2-Chloroethanol; 2-chloroethyl alcohol
- Appearance and odor: Colorless liquid with an ether-like odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethylene chlorohydrin is 5 parts of ethylene chlorohydrin per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 16 milligrams of ethylene chlorohydrin per cubic meter of air ( $\text{mg}/\text{m}^3$ ). The American Conference of Governmental Industrial Hygienists has recommended for ethylene chlorohydrin a Threshold Limit Value of 1 ppm with a skin notation.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Ethylene chlorohydrin can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It may be absorbed through the skin without causing irritation.

### • Effects of overexposure

Exposure to ethylene chlorohydrin vapor may cause irritation of the eyes, nose, throat, and lungs, nausea, vomiting, dizziness, poor coordination, numbness, visual disturbance, liver or kidney damage (lower concentrations may cause serious effects without causing irritation). Breathing in higher concentrations produces headache, thirst, delirium, low blood pressure, collapse,

and unconsciousness. The urine may contain blood. Death may occur from lung or brain damage. Absorption through the skin can cause the above symptoms without skin irritation. Prolonged overexposure to ethylene chlorohydrin may cause the skin to become yellow and a change in frequency of urination or the amount of urine.

### • 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 chlorohydrin.

### • Recommended medical surveillance

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

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

—Urinalysis: Since kidney damage has been observed from exposure, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on a semi-annual basis for the first two years and annually thereafter.

### • Summary of toxicology

Ethylene chlorohydrin vapor is highly toxic to the liver, kidneys, brain, and other organs. It is rapidly absorbed through the skin. A concentration of 250 ppm was fatal to rats in 4 hours; 125 ppm was not. A human fatality was reported following exposure to an estimat-

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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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ed 300 ppm for 2-¼ hours. In another fatal case, autopsy showed severe damage to the liver and brain. Several employees survived exposures averaging 18 ppm but showed signs of circulatory shock with incoordination and repeated vomiting. There is little margin of safety between early reversible symptoms and fatal intoxication. Absorption by any route, including the skin, may lead to severe illness or death. Contact with vapor causes irritation of mucous membranes, nausea, vomiting, vertigo, incoordination, numbness, and visual disturbance. With higher concentrations, headache, severe thirst, delirium, low blood pressure, collapse, shock, and coma may result. Urine may contain albumin, casts, and red blood cells. Death results from pulmonary edema or from congestion and edema of the brain. The cause of the toxic effect is probably the result of oxidation of the alcohol to chloroacetic acid. The liquid instilled in rabbit eyes caused moderately severe injury, but in human eyes corneal burns have been observed to recover within 48 hours. Skin contact is particularly hazardous, because there are no signs of immediate irritation to warn the victim of exposure.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 80.5
2. Boiling point (760 mm Hg): 130 C (266 F)
3. Specific gravity (water = 1): 1.2
4. Vapor density (air = 1 at boiling point of ethylene chlorohydrin): 2.8
5. Melting point: -62.6 C (-81 F)
6. Vapor pressure at 20 C (68 F): 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Miscible in all proportions

8. Evaporation rate (butyl acetate = 1): Data not available

### • Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong caustics may cause formation of flammable ethylene gas.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving ethylene chlorohydrin.

4. Special precautions: Ethylene chlorohydrin will attack some forms of plastics, rubber, and coatings. Special attention to the care and maintenance of personal protective equipment should be maintained.

### • Flammability

1. Flash point: 60 C (140 F) (closed cup)
2. Autoignition temperature: 425 C (797 F)
3. Flammable limits in air, % by volume: Lower: 4.9; Upper: 15.9
4. Extinguishant: Dry chemical, carbon dioxide, alcohol foam

### • Warning properties

According to the AIHA *Hygienic Guide*, the warning properties of ethylene chlorohydrin are "poor and inadequate to prevent injury."

Ethylene chlorohydrin is an eye irritant, according to the *Hygienic Guide*.

## MONITORING AND MEASUREMENT PROCEDURES

### • General

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

### • Method

Sampling and analyses may be performed by collection of ethylene chlorohydrin vapors using an adsorption tube with subsequent desorption with isopropyl alcohol in 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 chlorohydrin may be used. An analytical method for ethylene chlorohydrin 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 any possibility of skin contact with ethylene chlorohydrin.

- Clothing contaminated with liquid ethylene chlorohydrin should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of ethylene chlorohydrin from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethylene chlorohydrin, the person performing the operation should be informed of ethylene chlorohydrin's hazardous properties.
- Where there is any possibility of exposure of an employee's body to liquid ethylene chlorohydrin, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with liquid ethylene chlorohydrin should be removed immediately and not reworn until the ethylene chlorohydrin is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid ethylene chlorohydrin contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid ethylene chlorohydrin, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with liquid ethylene chlorohydrin should be immediately washed or showered to remove any ethylene chlorohydrin.
- Eating and smoking should not be permitted in areas where liquid ethylene chlorohydrin is handled, processed, or stored.
- Employees who handle liquid ethylene chlorohydrin should wash their hands thoroughly before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as a fumigant in treatment of seed potatoes	General dilution ventilation; personal protective equipment
Use in dyeing operations during color printing of textiles	Process enclosure; local exhaust ventilation

## Operation

Use during cleaning, degreasing, and dewaxing operations

Use in organic synthesis and synthesis of dyes, pharmaceuticals, and resin processing; use in extraction of pine lignin and oil of rose

## Controls

Material substitution; process enclosure; local exhaust ventilation

Process enclosure; local exhaust ventilation

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

### • Eye Exposure

If ethylene chlorohydrin 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 chlorohydrin gets on the skin, immediately flush the contaminated skin with water. If ethylene chlorohydrin soaks through the clothing, remove the clothing immediately and flush the skin with water. Get medical attention immediately.

### • Breathing

If a person breathes in large amounts of ethylene chlorohydrin, 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 chlorohydrin 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 chlorohydrin is spilled or leaked, the following steps should be taken:

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

• Waste disposal methods:

Ethylene chlorohydrin may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

## REFERENCES

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## RESPIRATORY PROTECTION FOR ETHYLENE CHLOROHYDRIN

Condition	Minimum Respiratory Protection* Required Above 5 ppm
Vapor Concentration	
10 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 10 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 chlorohydrin; 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 10 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.