

Occupational Health Guideline for Dichloroethyl Ether

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: $(\text{ClCH}_2\text{CH}_2)_2\text{O}$
- Synonyms: Bis(2-chloroethyl)ether; 2,2'-dichlorodiethyl ether
- Appearance and odor: Colorless liquid with a chlorinated solvent-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dichloroethyl ether is a ceiling level of 15 parts of dichloroethyl ether per million parts of air (ppm). This may also be expressed as 90 milligrams of dichloroethyl ether per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for dichloroethyl ether a Threshold Limit Value of 5 ppm with a skin notation.

HEALTH HAZARD INFORMATION

• Routes of exposure

Dichloroethyl ether can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

• Effects of overexposure

1. Short-term Exposure: Exposure to dichloroethyl ether vapor may cause severe irritation of the eyes and nose with coughing, retching, and nausea. In animal experiments, dichloroethyl ether has caused severe irritation of the respiratory tract with severe breathing difficulties which can be delayed in onset. Animal experiments have also shown dichloroethyl ether vapor to be capa-

ble of causing drowsiness, dizziness, and unconsciousness at high concentrations. Liquid dichloroethyl ether placed in animal eyes has produced damage. Feeding this chemical to mice has been associated with an increased amount of liver tumors.

2. Long-term Exposure: Repeated exposure to dichloroethyl ether may cause bronchitis.

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 dichloroethyl ether.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to dichloroethyl ether 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 tract, liver, and the central nervous system should be stressed.

—14" x 17" chest roentgenogram: Dichloroethyl ether causes lung damage in animals. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Dichloroethyl ether is a severe pulmonary irritant in animals. Periodic surveillance is indicated.

2. Periodic Medical Examination: The above medical examinations are to be repeated on an annual basis, except that an x-ray is necessary only when indicated by the results of pulmonary function testing, or signs and symptoms of respiratory disease.

• Summary of toxicology

Dichloroethyl ether vapor is a severe respiratory irritant; high levels cause narcosis in animals. It is tumorigenic in animals. Repeated oral administration of 100 mg/kg daily to both sexes of two strains of mice for 80 weeks induced a significantly elevated incidence of tumors, mostly hepatomas. In guinea pigs, concentrations of 500 to 1000 ppm were fatal after 5 to 8 hours of

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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exposure; there were immediate lacrimation and nasal irritation, followed by unsteadiness and coma; autopsy findings were pulmonary edema, hemorrhage and occasional complete consolidation. In experimental human exposure, 500 ppm caused intolerable irritation to the eyes and nose with cough, nausea and vomiting; at 100 ppm there was some irritation, while at 35 ppm there were no effects. Except for accidental inhalation of high concentrations, the chief hazard in industrial practice is mild bronchitis, which may be caused by repeated exposures to low concentrations. Both the liquid and a 10% solution dropped in the eye of a rabbit caused moderate discomfort, conjunctival irritation, and corneal injury which generally healed within 24 hours. On the skin of rabbits, the pure liquid had no local effect, but a sufficient amount penetrated the skin to cause death within a day.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 143
2. Boiling point (760 mm Hg): 178.2 C (353 F)
3. Specific gravity (water = 1): 1.2
4. Vapor density (air = 1 at boiling point of dichloroethyl ether): 4.9
5. Melting point: -52 C (-62 F)
6. Vapor pressure at 20 C (68 F): 0.4 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 1.1
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: At elevated temperatures containers may burst.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride and carbon monoxide) may be released in a fire involving dichloroethyl ether.
4. Special precautions: Dichloroethyl ether will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 55 C (131 F) (closed cup)
2. Autoignition temperature: 369 C (696 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Dry chemical, foam, carbon dioxide

• Warning properties

1. Odor Threshold: According to Patty, "most people can detect the chemical at its threshold limit (15 ppm) by its odor."
2. Irritation Levels: Patty states that "Schrenk, Patty, and Yant exposed human volunteers to dichloroethyl ether. Brief exposure to concentrations above 550 ppm were very irritating to the eyes and nasal passages and were considered intolerable. They also

caused coughing, retching, and nausea. At 260 and 100 ppm the irritating effects were still present to some extent but were not considered intolerable."

3. Evaluation of Warning Properties: Through its odor dichloroethyl ether can be detected at the permissible exposure limit. For the purposes of this guideline, therefore, dichloroethyl ether is treated as a substance with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• Ceiling Evaluation

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

• Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure dichloroethyl ether may be used. An analytical method for dichloroethyl ether is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

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 dichloroethyl ether, where skin contact may occur.
- Clothing contaminated with dichloroethyl ether should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of dichloroethyl ether from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the dichloroethyl ether, the person performing the operation should be informed of dichloroethyl ether's hazardous properties.
- Where exposure of an employee's body to liquid dichloroethyl ether may occur, 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 dichloroethyl ether should be removed immediately and not reworn until the dichloroethyl ether is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid dichloroethyl ether may contact the eyes.

SANITATION

- Skin that becomes contaminated with dichloroethyl ether should be immediately washed or showered with soap or mild detergent and water to remove any dichloroethyl ether.
- Employees who handle dichloroethyl ether should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as solvent, dewaxing agent in petroleum industry and manufacture of oils, fats, waxes, gums, tars, resins, soaps, ethyl cellulose, paints, varnish, and lacquers	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as scouring and penetrating agent in textile industry	Local exhaust ventilation; general dilution ventilation; personal protective equipment

Operation

Use as fumigant in agricultural insecticide industry

Use as chemical intermediate in synthesis during manufacture of pharmaceuticals, rubber chemicals, resins, plasticizers, and chemicals

Use as lead scavenger during production of gasoline engine anti-knock compounds

Controls

Personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

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

• Eye Exposure

If liquid dichloroethyl ether 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 dichloroethyl ether gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If liquid dichloroethyl ether soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention promptly.

• Breathing

If a person breathes in large amounts of dichloroethyl ether, 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 liquid dichloroethyl ether has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• 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 dichloroethyl ether 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 reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Dichloroethyl ether should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of dichloroethyl ether vapors are permitted.

- Waste disposal methods:

Dichloroethyl ether 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.

ADDITIONAL INFORMATION

To find additional information on dichloroethyl ether, look up dichloroethyl ether in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

REFERENCES

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 9, 1975.

RESPIRATORY PROTECTION FOR DICHLOROETHYL ETHER

Condition	Minimum Respiratory Protection* Required Above 15 ppm
Vapor Concentration	
150 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s).** Any supplied-air respirator.** Any self-contained breathing apparatus.**
250 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 250 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.

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.

***Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of dichloroethyl ether; 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 250 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

