

Occupational Health Guideline for Propylene Dichloride

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: $\text{CH}_3\text{CHClCH}_2\text{Cl}$
- Synonyms: 1,2-Dichloropropane
- Appearance and odor: Colorless liquid with an odor like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for propylene dichloride is 75 parts of propylene dichloride per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 350 milligrams of propylene dichloride per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Propylene dichloride can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

• Effects of overexposure

1. *Short-term Exposure:* Overexposure to propylene dichloride causes eye and skin irritation and may cause drowsiness or lightheadedness.

2. *Long-term Exposure:* Prolonged overexposure to propylene dichloride may affect the liver and kidneys.

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 propylene dichloride.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to propylene dichloride 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 propylene dichloride exposure.

—Skin disease: Propylene dichloride can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

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

—Kidney disease: Propylene dichloride 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 propylene dichloride might cause exacerbation of symptoms due to its irritant properties.

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

• Summary of toxicology

Propylene dichloride vapor is a narcotic and an eye irritant. At 2200 ppm for 7 hours, guinea pigs developed severe conjunctival swelling, as well as signs of respiratory irritation and incoordination; some died after 5 daily exposures, showing severe liver injury, some kidney injury, and occasional adrenal changes. Repeated inhalation of 1000 ppm caused some deaths among dogs after 24 exposures of 7 hours' duration, and among rats after only 7 exposures. There was early onset of lacrimation, eye irritation, and incoordination. Liver damage was the main finding in the animals that died. At 400 ppm, rats and guinea pigs exposed for up to 140

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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daily 7-hour exposures showed no ill effects and no histologic changes. However, of a group of C3H-strain mice exposed at 400 ppm, some died; others developed hepatomas, a finding of equivocal significance. Propylene dichloride is mildly irritating to human skin, and some skin absorption may occur from exposure to the liquid. The undiluted liquid is moderately irritating to the eyes but does not cause permanent injury.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 113
2. Boiling point (760 mm Hg): 96.1 C (205 F)
3. Specific gravity (water = 1): 1.16
4. Vapor density (air = 1 at boiling point of propylene dichloride): 3.9
5. Melting point: -100 C (-148 F)
6. Vapor pressure at 20 C (68 F): 39.5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.26
8. Evaporation rate (butyl acetate = 1): Greater than 1

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions. Strong acids may cause decomposition.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide and hydrogen chloride) may be released in a fire involving propylene dichloride.

4. Special precautions: Propylene dichloride will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 15.6 C (60 F) (closed cup)
2. Autoignition temperature: 557 C (1035 F)
3. Flammable limits in air, % by volume (at 100 C): Lower: 3.4; Upper: 14.5
4. Extinguishant: Dry chemical, foam, carbon dioxide

• Warning properties

1. Odor Threshold: May reports an odor threshold of 50 ppm. The AIHA *Hygienic Guide* states that "human subjects described the odor as 'strong' at 130 to 190 ppm and 'not noticeable' at 15 to 23 ppm."

2. Eye Irritation Level: According to Grant, "exposure of guinea pigs to 2200 ppm in air for many hours until most were dead caused lacrimation and swelling of the lids and conjunctiva. To the extent that the corneas were left unprotected, bluish discoloration of the corneas and infection developed. Rabbits exposed to the same conditions showed little irritation." No quantitative information is available concerning the threshold of eye irritation. No ill effects have been observed in animals chronically exposed to 400 ppm.

3. Evaluation of Warning Properties: Since the odor threshold of propylene dichloride is below the permissible exposure limit, this substance is treated as a material

with adequate warning properties.

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 propylene dichloride 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 propylene dichloride may be used. An analytical method for propylene dichloride 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). PB 265 026).

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 propylene dichloride.

• Clothing wet with liquid propylene dichloride should be placed in closed containers for storage until it can be

discarded or until provision is made for the removal of propylene dichloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the propylene dichloride, the person performing the operation should be informed of propylene dichloride's hazardous properties.

- Any clothing which becomes wet with liquid propylene dichloride should be removed immediately and not reworn until the propylene dichloride is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid propylene dichloride may contact the eyes.

SANITATION

- Skin that becomes wet with liquid propylene dichloride should be promptly washed or showered with soap or mild detergent and water to remove any propylene dichloride.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as a soil fumigant for protection of fruit and nut crops, field crops, beets, and tobacco against nematodes	Adequate ventilation; personal protective equipment
Use in cleaning, degreasing, and spot removal operations including paint and varnish removal	Local exhaust ventilation; personal protective equipment
Use during rubber compounding and vulcanizing operations	Local exhaust ventilation; personal protective equipment
Use during extraction processing of fats, oils, lactic acid, and petroleum waxes	Local exhaust ventilation; personal protective equipment
Use in the manufacture of tetrachloroethylene and propylene oxide	Local exhaust ventilation; personal protective equipment
Use as an additive and lead scavenger in antiknock fluids	Local exhaust 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 propylene dichloride gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If propylene dichloride gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If propylene dichloride soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of propylene dichloride, 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 propylene dichloride 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 propylene dichloride 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. Propylene dichloride should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal method:

Propylene dichloride may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Propylene Dichloride," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Propylene Dichloride," *Hygienic Guide Series*, Detroit, Michigan, 1967.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Heppel, L. A., et al.: "Toxicology of 1, 2-Dichloropropane (Propylene Dichloride) I. Studies on Effects of Daily Inhalations," *Journal of Industrial Hygiene and Toxicology*, 28:1-8, 1946.
- Heppel, L. A., Highman, B., and Peake, E. G.: "Toxicology of 1,2-Dichloropropane (Propylene Dichloride) IV. Effects of Repeated Exposures to a Low Concentration of the Vapor," *Journal of Industrial Hygiene and Toxicology*, 30:189-191, 1948.
- May, J.: "Solvent Odor Thresholds for the Evaluation of Solvent Odors in the Atmosphere," *Staub-Reinhalt*, 26:9, 385-389, 1966.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.

RESPIRATORY PROTECTION FOR PROPYLENE DICHLORIDE

Condition	Minimum Respiratory Protection* Required Above 75 ppm
Vapor Concentration	
400 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
2000 ppm or less	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 2000 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.