NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DICHLOROETHYL ETHER

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. 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 2 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 exposure; there was 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 percent 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.

III. SIGNS AND SYMPTOMS

Lacrimation, irritation of nose and throat, cough; nausea, vomiting; by analogy to effects caused in animals, it may cause pulmonary irritation and edema; liver tumors.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Promptly flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Consideration should be given to hospitalization and observation for the possible delayed onset of pulmonary edema, and to treatment with corticosteroids if pulmonary edema occurs.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Dichloroethyl ether is a severe respiratory irritant in animals. It is tumorigenic in animals. Skin absorption is known to occur. It is important that the physician become familiar with plant operating conditions in which exposure to dichloroethyl ether occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

The following medical procedures must be made available to each employee who is exposed to dichloroethyl ether:

1. A complete history and physical examination -- The purpose is to detect preexisting 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.

2. 14" x 17" chest roentgenogram -- Dichloroethyl ether causes lung damage in animals. Surveillance of the lungs is indicated.

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

C. PERIODIC EXAMINATIONS

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

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Dichloroethyl Ether," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 311.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1673-1677.

3. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 513-516.

4. Innes, J.R.M., et al: "Bioassay of Pesticides and Industrial Chemicals for Tumorigenicity in Mice: A Preliminary Note," Journal of the National Cancer Institute, 42:1101-1114, 1969.

REFERENCES AND SOURCES
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1910.1000

(d) Compliance - Open surface tank classification based on relative evaporation rate of 70 hours (from Doolittle)

(e) Fire and Safety

(1) Electrical - Classification based on "Fire Hazard Classification of Chemical Vapors Relative to Explosion-proof Electrical Equipment," H. Carhart et al., National Academy of Sciences, 1973, report to U.S. Coast Guard, report no. CG-D-92-74, p. 11.

(f) Personal Protective Equipment, and, (h) Sanitation

Eye: Browning, "Toxicity and Metabolism of Industrial Solvents;" Patty, "Industrial Hygiene and Toxicology;" Grant, "Toxicology of the Eye"

Skin: Browning, "Toxicity and Metabolism of Industrial Solvents;" Union Carbide Corporation, "Toxicology Studies;" Spector, "Handbook of Toxicology;" Patty, "Industrial Hygiene and Toxicology"

Ingestion: Browning, "Toxicity and Metabolism of Industrial Solvents;" Union Carbide Corporation, "Toxicology Studies;" Patty, "Industrial Hygiene and Toxicology;" Spector, "Handbook of Toxicology"

COMMENTS

Eye - Classification: 2
Output statement numbers: 10
Exceptions: None

According to Browning, "application to the cornea of rabbits caused injury which was graded by Carpenter and Smyth as of moderate severity; Hake and Rowe state that both pure compound and also a 10% solution in propylene glycol cause moderate pain, conjunctival irritation and corneal injury which generally heals within a short time." Patty says "from these results it is evident that exposure of human eyes . . . could cause serious damage, although probably not permanent loss of vision."

Grant says that "one instance of burn of a human cornea, possibly from a splash, has been listed without details. Tests on rabbit eyes by application of a drop have caused mild transient injury, graded 4 on a scale of 1 to 10 after twenty-four hours."

Since there is no evidence that this substance causes permanent eye damage, it is concluded that a classification of 2 is appropriate.

Skin - Classification: 2
Output statement numbers: 2, 7a, 8b, 14g, 14i, 20a
Exceptions: See below

According to Browning, the substance is "not acutely irritant to the skin, but it can be absorbed rapidly with lethal effect . . ." By skin application, the LD50 for rabbits is given as 90 mg/kg in 10% solution in propylene glycol.

By the poulticing method, the guinea pig skin LD50 is 0.3 ml/kg.

Union Carbide gives a skin penetration LD50 for rabbits of 0.72 milliliters per kilogram body weight. It adds, "this result suggests that skin penetration in harmful amounts may occur after moderate contact in terms of skin area involved and duration of contact."

For skin irritation, it reports "the undiluted chemical caused no reaction on the tender skin of the rabbit belly greater than a faint redness of short duration."

Spector reports that this substance "at 10% concentrations or above must carry a warning indicating that it may be fatal . . via skin by human beings. Caution is recommended, in concentrations below 10%, against . . . skin contact." He gives the cutaneous LD50 for the rabbit as 410 mg/kg.

According to Patty, "Smyth and Carpenter reported that dichloroethyl ether has a mild primary irritating effect on the skin. Allen stated that, 'the pure liquid has no irritative effect or indeed any other effect on the skin, a factor greatly in its favour.' This has essentially been confirmed by studies with rabbits, which showed that a 10 per cent solution of the compound has very little or no effect on the intact or abraded skin after repeated applications. However, . . . acutely toxic amounts rapidly penetrated the skin and caused death within a day. Using graded doses of a 10 per cent solution of dichloroethyl ether in propylene glycol, the LD50 for 24-hour skin absorption in rabbits was calculated to be 90 mg/kg, . . . From these results it is obvious that, although dichloroethyl ether is not a primary skin irritant, contact with the skin should be avoided because of its rapid absorption and deleterious consequences."

Dichloroethyl ether has a boiling point of 353 degrees F, a melting point of -62 degrees F and a vapor pressure of 20 degree C of 0.4 mm Hg. It is 1.1% soluble in water and has a flash point of 131 degrees F.

Skin absorption of this compound presents a definite hazard. It is concluded that a classification of 2 is appropriat if statement 2 is used to prevent contact where it "may occur," statement 8b is used, and statements 14g and 14i are used instead of statements 17g and 17i.

Ingestion - Classification: 2

Output statement numbers: 20a

Exceptions: None

Union Carbide gives an oral LD50 for the rat of 0.105 gm/kg and states "this is a highly toxic chemical when swallowed."

Browning gives oral LD50 for various animal species which range from 75 to 136 mg/kg.

Spector states that "at 10% concentrations or above must carry a warning that it may be fatal if . . . swallowed . . . by human beings. Caution is recommended, in cases of concentrations below 10%, against . . . swallowing. .

Patty notes "there have been no studies reported on the repeated oral feeding of dichloroethyl ether."

It is clear that the literature considers this substance

to be highly toxic by ingestion. Since it is a liquid at normal ambient temperatures it is . . concluded that a classification of 2 is sufficient to prevent excessive ingestion (in the context of this standard).

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)

Eastman Kodak Co., Material Safety Data Sheet (EK)

Olin Mathieson Chemical Corp., "Mathieson Organic Chemicals" (Olin) (obsolete

H. R. Fife and E. W. Reid, Ind. Eng. Chem., 22, p. 513, 1930 (F and R)

Sources of data items used:

I.	A.	1.	Synonyms: NFPA-325M
		2.	Formula: EK
		3.	Molecular weight: Olin
	B.	1.	Boiling point: NFPA-325M, F and R
		2.	Specific gravity: NFPA-325M, F and R
		3.	Vapor density: NFPA-325M
		4.	Melting point: F and R
		5.	Vapor pressure: F and R
		6.	Solubility in water: Olin
		7.	Evaporation rate: Data not available
		8.	Appearance and odor: NFPA-49
II.	A.	1.	Flash point: NFPA-325M, F and R
		2.	Autoignition temperature: NFPA-49, F and R
		3.	Flammable limits: Data not available
		4.	Extinguishing media: NFPA-49, EK
		5.	Special fire fighting procedures: NFPA-49
		6.	Unusual fire and explosion hazards: NFPA-49
	B.	1.	Conditions contributing to instability: ADL
		2.	Incompatibilities: ADL
		3.	Hazardous decomposition products: NFPA-49
		4.	Special precautions: Olin
III.	A.		Steps if released or spilled: NFPA-49, EK
	C.		Waste disposal method: EK
V.			Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

"Bis(2-chloroethyl)ether," Material Safety Data Sheet, Eastman Kodak Company, 8/23/74 (MSDS)

Browning, E., "Toxicity and Metabolism of Industrial Solvents," Elsevier Publishing Co., 1965 (Browning)

"Dichloroethyl Ether," Hazard Process Index, Hazard Entry #56, NIOSH HSM-99-73-62 (HPI)

"Dichloroethyl Ether," Hygienic Information Guide, No. 53, Commonwealth of Pennsylvania, Dept. of Environmental Resources, 5/72 (Guide No. 53)

"EPA Compendium of Registered Pesticides," U. S. Environmental Protection Agency, vol. III, 3/29/74 (EPA)

International Labour Office, "Encyclopedia of Occupational Health and Safety," 1972 (ILO)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, 2nd edition, vol. 8, 1965 (K-O)

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"Mathieson Organic Chemicals," Olin Mathieson Chemical Corporation, "Dichloroethyl Ether," p. 23 (Mathieson)

References for Specific Use/Exposure

1. Guide No. 53, HPI, K-O
2. Browning, HPI, Mathieson
3. EPA, HPI, K-O
4. HPI, Mathieson
5. HPI
6. K-O, Mathieson
7. Browning, ILO, K-O
8. K-O, Mathieson
9. MSDS

References for Specific Control Methods

Guide No. 53 and MSDS were the references used in all the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Dichloroethyl ether

D. O. L. STANDARD: 15 ppm shall not be exceeded

WARNING PROPERTIES:

Odor Threshold: Patty states that "most people can detect the chemical at its threshold limit (15 ppm) by its odor."

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."

For the purposes of this standard, half-facepiece respirators are allowed up to a concentration of 150 ppm unless eye irritation occurs. If eye irritation occurs, a full facepiece respirator must be worn.

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

IDLH: 250 ppm

Basis for IDLH Value: The chosen IDLH is based upon Patty's report that 250 ppm caused death in rats from a 4-hour exposure. A concentration of 500 - 1000 ppm might cause death in guinea pigs from an exposure of only 30 to 60 minutes duration (Patty).

Other Toxicological Information: Browning states that "dichloroethyl ether is primarily a severe respiratory irritant; it can also be narcotic in high concentrations, but the extreme irritation from non-narcotic concentrations makes the occurrence of narcosis unlikely. Animal experiments have indicated that it is a highly toxic compound, but death even when delayed, has been considered to be due to respiratory injury; accompanying congestion of other organs is apparently a secondary phenomenon.

"It is not acutely irritant to the skin, but can be absorbed rapidly with lethal effect. In human beings the vapour is highly irritant to the eyes, nose and respiratory passages."

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The Documentation of TLV's states that "Schrenk and co-workers found 35 ppm to be the highest concentration of dichloroethyl ether vapor which did not cause a serious response in guinea pigs after several hours' exposure. Levels of 500 to 1000 ppm caused immediate severe eye irritation, and were fatal in 60 minutes. The chief lesions were in the respiratory tract, but some effects were seen in the brain, liver and kidneys. Cook recommended that concentrations in workrooms be kept below 15 ppm.

"Carpenter et al. found 250 ppm lethal to animals in four hours. According to Patty repeated exposures of animals at 69 ppm caused no serious ill effects, but there was some depression in the rate of growth. Smyth and Carpenter considered dichloroethyl ether to be in the same toxicity group as ethylene chlorohydrin. It acute toxicity was found comparable to that of allyl alcohol, aniline, epichlorohydrin and formaldehyde, substances with TLV's of 5 ppm or less. On the other hand, Smyth later stated that the limit of 15 ppm should be low enough to avoid injury.

"Although dichloroethyl ether has found considerable use in industry, no well-documented cases of occupational intoxication have been recorded. Elkins noted the statement of an industrial chemist, that use of a mixture containing dichloroethyl ether in the wool industry caused the death of a worker, presumably through inhalation of the vapor. Bell and Jones reported an episode of hysteria in a plant after it had been fumigated with a solution of chlordane in dichloroethyl ether and kerosene. They noted slight eye irritation from a concentration of 2.5 ppm of dichloroethyl ether.

"The TLV of 15 ppm is believed low enough to prevent serious injury to the lungs but may not eliminate all complaints of irritation o the eyes and upper respiratory passages."

Patty also states that "Schrenk, Patty, and Yant studied the effect of inhalation of dichloroethyl ether vapors upon the guinea pig. Concentrations of 500 to 1000 ppm caused immediate, severe eye and nasal irritation as evidenced by lachrymation and scratching of the nose. After 1 1/2 to 3 hours at these concentrations, respiratory disturbances were evident, with death taking place after 5 to 8 hours of continuous exposure. The chief lesions in these animals were in the respiratory organs, with some effects noted in the brain, kidneys, and liver. Even if exposure at these concentrations was stopped after 90 minutes, many of the animals died later from lung lesions. The authors, therefore, suggested that an exposure of 30 to 60 minutes duration to dichloroethyl ether vapor at a concentration of 500 to 1000 ppm was dangerous to the life of the guinea pig. Ten to 15 hours of continuous exposure to 105 and 260 ppm eventually caused death. However, if the exposure time to 100 ppm was limited to 1 hour, no serious disturbances resulted, even though eye and nose irritation was still evident. The latter was indicated even at 365 ppm, although there were no other signs of adverse effects and no deaths after 13 1/2 hours of continuous exposure. Smyth and Carpenter exposed rats to 1000 ppm vapor for 45 minutes. Three of 6 animals died with 14 days. This group also reported deaths in rats when they were exposed to 250 ppm vapor for a single 4-hour period. They classified this compound in the 'definite hazard' group."

Concerning absorption through the skin, Patty states that "using graded doses of a 10 per cent solution of dichloroethyl ether in propylene glycol, the LD50 for 24-hour skin absorption in rabbits was calculated to be 90 mg/kg, with 19/20 confidence limits of 55 to 145 mg/kg. Smyth and Carpenter reported an LD50 for guinea pigs of 0.3 ml/kg, using the poultice method of testing. From these results it is obvious that, although dichloroethyl ether is not a primary skin irritant, contact with the skin should be avoided because of its rapid absorption and deleterious consequences."

LFL: Data not available

VAPOR PRESSURE AT 20 C: 0.4 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 5260 ppm

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USE/EXPOSURE AND CONTROL DOCUMENT
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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during use in the petroleum industry (selective solvent - dewaxing agent for lubricating oils, separation of butadiene from butylene, separation of high and low viscosity index constituents of crude lubricating oil, extraction of sludge - forming materials in lubricating oils)	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles)
2.	Inhalation of vapor and skin contact with liquid during use in the textile industry (textile scouring agent - "kier boiling," for peroxide bleaching where a penetrating agent is needed, as an aid to desizing and mercerizing, in fulling process, for grease spotting)	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (glvoes, goggles)
3.	Inhalation of vapor and skin contact with liquid during use as an agricultural insecticide (soil, space and spot spray fumigant). Soil fumigant - outstanding soil fumigant butphytotoxic so can be used only on bare soils - as liquid emulsion, especially valuable for greenhouse use; space fumigant - to protect stored tobacco; spot spray - for wasps and spiders.	A,D	Personal protective equipment (goggles, gloves, protective clothing, respiratory protective devices - as needed)
4.	Inhalation of vapor and skin contact with liquid	A,D	Local exhaust ventilation; general dilution ventila-

	during use in the chemical synthesis (morpholine, n-ethyl morpholine, vinyl ether). It is used as a raw material or chemical intermediate in the manufacture of pharmaceuticals, rubber chemicals, insecticides, textiles chemicals, resins and plasticizers.		tion; personal protective equipment (gloves, goggles)
5.	Inhalation of vapor and skin contact with liquid during the synthesis and processing of dichloroethyl ether (by-product in synthesis of ethylene oxide; reaction of ethylene chlorohydrin with sulfuric acid)	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles)
6.	Inhalation of vapor and skin contact with liquid during use as a general solvent (oils, fats, waxes, gums, tars, natural and synthetic resins, soaps, ethyl cellulose)	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles)
7.	Inhalation of vapor and skin contact with liquid duriuse in the paint, varnish and lacquer industry (solvent and blending agent)	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles)
8.	Inhalation of vapor and skin contact with liquid during production of gasoline engine anti-knock compounds (dichloroethyl ether is a lead scavenger)	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles)
9.	Inhalation of vapor and skin contact with liquid during cleaning and maintenance of storage vessels and equipment and during clean up of accidental spills	A,D	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, protective clothing, respiratory protective devices)

A -- Inhalation
B -- Skin and eye contact resulting in localized irritation
C -- Ingestion
D -- Skin contact resulting in absorption and subsequent systemic poisoning

NOTE: In 1976 there was no production or use of dichloroethyl ether in the United States which could be identified.