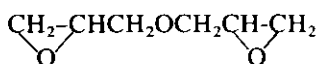


OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIGLYCIDYL ETHER POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

This guideline summarizes pertinent information about diglycidyl ether (DGE) for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

- **Formula:** C₆H₁₀O₃
- **Structure:** 
- **Synonyms:** Bis(2,3-epoxypropyl) ether; DGE; di(2,3-epoxypropyl) ether; di(2,3-epoxy)propyl ether
- **Identifiers:** CAS 2238-07-05; RTECS KN2350000; DOT not assigned
- **Appearance and odor:** Colorless liquid with a strong, irritating odor

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
 1. Molecular weight: 130.16
 2. Boiling point (at 760 mmHg): 260°C (500°F)
 3. Specific gravity (water = 1): 1.26
 4. Vapor density (air = 1 at boiling point of DGE): 4.49
 5. Vapor pressure at 25°C (77°F): 0.09 mmHg
 6. Saturation concentration in air (approximate) at 25°C (77°F): 0.0121% (121 ppm)
- **Reactivity**
 1. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions. Ethers as a class tend to form

- peroxides upon contact with air and exposure to light.
2. Hazardous decomposition products: Toxic vapors and gases (e.g., carbon monoxide) may be released in a fire involving DGE.
3. Caution: DGE will cause some forms of plastics, coatings, and rubber to deteriorate.

- **Flammability**

1. Flash point: 64°C (147°F)
2. Extinguishant: Dry chemical, carbon dioxide, alcohol foam
3. Class IIIA Combustible Liquid (29 CFR 1910.106)

- **Warning properties**

1. Odor threshold: Approximately 5 ppm
2. Eye irritation levels: 10 ppm
3. Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for DGE is 0.5 parts of DGE per million parts of air (ppm) [2.8 milligrams of DGE per cubic meter of air (mg/m³)] as a ceiling concentration which shall at no time be exceeded. The National Institute for Occupational Safety and Health (NIOSH) recommends that DGE be controlled and handled as a potential human carcinogen in the workplace and that exposure be reduced to the lowest feasible limit. The NIOSH recommended exposure limit (REL) is 0.2 ppm (1 mg/m³) as a ceiling concentration determined in any 15-minute sampling period. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) is 0.1 ppm (0.5 mg/m³) as a time-weighted average (TWA) concentration for a normal 8-hour workday and a 40-hour workweek (Table 1).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

Table 1.—Occupational exposure limits for diglycidyl ether

	Exposure limits	
	ppm	mg/m ³
OSHA PEL Ceiling	0.5	2.8
NIOSH REL (Ca)* Ceiling (15 min)	0.2	1
ACGIH TLV® TWA	0.1	0.5

* (Ca): NIOSH recommends treating as a potential human carcinogen.

HEALTH HAZARD INFORMATION

• Routes of exposure

DGE may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

• Summary of toxicology

Effects on animals: In mice and rats, acute inhalation or oral administration of DGE caused central nervous system depression, incoordination, breathing difficulty (dyspnea), respiratory failure, and death. In rats and rabbits, acute or subchronic inhalation or dermal administration of DGE produced weight loss, corneal opacities, testicular degeneration, and abnormalities of the blood-forming tissues including lymphoid atrophy of the thymus and depression of white blood cell and bone marrow cell counts. In skin-painting studies, DGE produced tumors in mice. DGE was mutagenic in bacterial test systems.

• Signs and Symptoms of exposure

1. *Short-term (acute):* Exposure to DGE can cause skin burns and severe irritation of the skin, eyes, and respiratory tract.
2. *Long-term (chronic):* Exposure to DGE can cause dermatitis and skin sensitization.

RECOMMENDED MEDICAL PRACTICES

• Medical surveillance program

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in in-

dividual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

• Preplacement medical evaluation

Prior to placing a worker in a job with a potential for exposure to DGE, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, reproductive, respiratory, nervous, and hematopoietic (blood cell forming) systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to DGE at or below the NIOSH REL. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include a history of chronic skin disease or concurrent dermatitis.

• Periodic medical screening and/or biologic monitoring

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to DGE. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the physiologic function of the eyes, skin, reproductive, nervous, respiratory and hematopoietic systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population. The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and the ATS: standardized questionnaires and tests of lung function.

• Medical practices recommended at the time of job transfer or termination

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to DGE may cause adverse reproductive effects or diseases of prolonged

induction-latency, the need for medical surveillance may extend well beyond termination of employment.

- **Sentinel health events**

Acute SHE's include: Contact and/or allergic dermatitis

MONITORING AND MEASUREMENT PROCEDURES

- **Ceiling concentration evaluation**

Measurements to determine worker exposure should be taken during periods of maximum expected airborne concentrations of DGE. Each measurement to determine the NIOSH REL (ceiling exposure) in the worker's breathing zone (air that most nearly represents that inhaled by the worker) should consist of a 15-minute sample or a series of consecutive samples that total 15 minutes. A minimum of three measurements should be taken during one workshift, and the highest of all measurements taken is an estimate of the worker's exposure. If the periods of maximum exposure are not clearly defined, a statistical procedure which can be used as a peak exposure detection strategy is given in the *Occupational Exposure Sampling Strategy Manual*.

- **Method**

Sampling and analysis may be performed by collecting DGE vapors with charcoal adsorption tubes followed by desorption with methylene chloride and analysis by gas chromatography. Refer to the *Criteria for Recommended Standard*. . . . *Occupational Exposure to Glycidyl Ethers* for limitations and correct use of this method. Direct-reading devices calibrated to measure DGE may also be used if available.

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with DGE.

SANITATION

Clothing which is contaminated with DGE should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of DGE from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of DGE's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with DGE should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle DGE should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

DGE is not generally used outside of research laboratories. There are no common industrial uses for DGE.

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

- **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to DGE, an eye-wash fountain should be provided within the immediate work area for emergency use.

If DGE gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

- **Skin exposure**

Where there is any possibility of a worker's body being exposed to DGE, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If DGE gets on the skin, wash it immediately with soap and water. If DGE penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

- **Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. 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.

SPILLS AND LEAKS

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

If DGE 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 of liquids containing DGE, absorb on paper towels and place in an appropriate container.
4. Large quantities of liquids containing DGE may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container.
5. Liquids containing DGE may be collected by vacuuming with an appropriate system. If a vacuum system is used, there should be no sources of ignition in the vicinity of the spill, and flashback prevention devices should be provided.

WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure: when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations including those requiring confined-space entry (Table 2).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards, 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

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Table 2.—Respiratory protection for diglycidyl ether

Condition	Minimum respiratory protection*
Any detectable concentration	<p>Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode</p> <p>Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode</p>
Planned or emergency entry into environments containing unknown or any detectable concentration	<p>Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode</p> <p>Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode</p>
Firefighting	<p>Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode</p>
Escape only	<p>Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister</p> <p>Any appropriate escape-type or self-contained breathing apparatus</p>

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

