

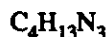
OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIETHYLENETRIAMINE

INTRODUCTION

This guideline summarizes pertinent information about diethylenetriamine for workers and employers as well as for physicians, industrial hygienists, and other 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 Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

• Formula



• Structure



• Synonyms

DETA; N-(2-aminoethyl)1,2-ethanediamine; 2,2'-diaminodiethylamine; aminoethylethandiamine; bis(2-aminoethyl)amine; bis(beta-aminoethyl)amine; N,N-bis(2-aminoethyl)amine; 2,2'-iminobisethylamine

• Identifiers

1. CAS No.: 111-40-0

2. RTECS No.: IE1225000

3. DOT UN: 2079 29

4. DOT label: Corrosive

• Appearance and odor

Diethylenetriamine is a combustible, somewhat viscous, colorless to yellow liquid with an ammonia-like odor. This substance is hygroscopic and strongly alkaline.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 103.17

2. Boiling point (760 mm Hg): 207°C (405°F)

3. Specific gravity (water = 1): 0.96 at 20°C (68°F)

4. Vapor density (air = 1 at boiling point of diethylenetriamine): 3.56

5. Melting point: -39°C (-38°F)

6. Vapor pressure at 20°C (68°F): 0.37 mm Hg

7. Solubility: Completely soluble in water; soluble in hydrocarbons; insoluble in ether.

8. Evaporation rate (ether = 1): Greater than 400

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Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Education and Information Division

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Occupational Safety and Health Administration

Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame
2. Incompatibilities: Contact of diethylenetriamine with oxidizing materials or strong acids may cause a violent reaction; in contact with cellulose nitrate, this substance ignites spontaneously. In contact with silver, cobalt, or chromium compounds, certain diethylenetriamine complexes can be explosive.
3. Hazardous decomposition products: Toxic gases (such as oxides of nitrogen and carbon, and hydrocarbons) may be released in a fire involving diethylenetriamine.
4. Special precautions: Diethylenetriamine is corrosive to copper and its alloys.

Flammability

The National Fire Protection Association has assigned a flammability rating of 1 (slight fire hazard) to diethylenetriamine.

1. Flash point: 98°C (208°F) (open cup)
2. Autoignition temperature: 358°C (676°F)
3. Flammable limits in air (percent by volume): Lower, 2; upper, 6.7
4. Extinguishant: Use water spray, alcohol foam, carbon dioxide, or dry chemical to fight fires involving diethylenetriamine. Water may be ineffective, but it may be used to cool fire-exposed containers. If a leak or spill has not ignited, water spray may be used to disperse vapors and to protect persons attempting to stop the leak.

Fires involving diethylenetriamine should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapor explosion and poison hazards may occur indoors, outdoors, or in sewers. Vapors may travel to a source of ignition and flash back. Containers of diethylenetriamine may explode in the heat of the fire and should be moved from

the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if they hear a rising sound from a venting safety device or if there is discoloration of a container due to fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half a mile in all directions. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving diethylenetriamine. Structural firefighters' protective clothing may provide limited protection against fires involving diethylenetriamine.

EXPOSURE LIMITS

• OSHA PEL

The Occupational Safety and Health Administration (OSHA) had not promulgated a permissible exposure limit (PEL) for diethylenetriamine [29 CFR 1910.1000, Table Z-1].

• NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for diethylenetriamine of 1 ppm (4 mg/m³) as a TWA for up to a 10-hr workday and a 40-hr workweek with a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overall exposure [NIOSH 1992].

• ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned diethylenetriamine a threshold limit value (TLV) of 1 ppm (4.2 mg/m³) as a TWA for a normal 8-hr workday and a 40-hr workweek. The ACGIH has also assigned diethylenetriamine a "Skin" notation [ACGIH 1993].

• Rationale for limits

The NIOSH and ACGIH limits are based on the risk of skin and respiratory tract irritation and sensitization associated with exposure to diethylenetriamine.

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to diethylenetriamine can occur through inhalation, ingestion, eye or skin contact, and percutaneous absorption.

• Summary of toxicology

1. **Effects on Animals:** Diethylenetriamine is a severe irritant of the eyes and skin in animals. Application of this substance to rabbit skin caused severe injury, and instillation into the eyes of rabbits caused maximum damage to the cornea [Clayton and Clayton 1981; Grant 1986]. The dermal LD₅₀ in rabbits is 1,090 mg/kg [NIOSH 1994]. Acutely poisoned animals convulsed and exhibited signs of gastrointestinal irritation before death [NIOSH 1994]. Rats exposed once to a 300-ppm concentration of diethylenetriamine for 8 hours survived [ACGIH 1986]. The oral LD₅₀ in rats is 1,080 mg/kg [NIOSH 1994].
2. **Effects on Humans:** Diethylenetriamine is a severe irritant of the eyes, skin, mucous membranes, and upper respiratory tract and a potent skin and pulmonary sensitizer in humans. In contact with the skin, diethylenetriamine causes severe irritation, with edema and sometimes necrosis [Grant 1986]. A majority of workers chronically exposed to this substance are reported to develop sensitization to it. Exposure to the heated vapor of diethylenetriamine (concentration not specified) causes respiratory tract irritation, and pulmonary sensitization is reported to occur with "relatively high frequency" [NLM 1993; ACGIH 1991].

• Signs and symptoms of exposure

1. **Acute exposure:** The signs and symptoms of acute exposure to diethylenetriamine vapors include eye and respiratory tract irritation, with tearing and redness of the eyes, coughing, and difficult breathing. Contact of the eyes or skin with the liquid causes corneal or skin burns, with blistering, swelling, redness, and cell death.
2. **Chronic exposure:** Repeated exposure to diethylenetriamine may cause an asthmatic response in sensitized individuals. Repeated contact of the skin with this substance may cause dermatitis, with redness and

scaling, or skin sensitization, accompanied by redness, itching, and the development of wheals.

• Emergency procedures

WARNING!

Transport victims immediately to emergency medical facility!

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. *Immediately* initiate the following emergency procedures, continuing them as appropriate en route to the emergency medical facility:

1. **Eye exposure:** Tissue destruction and blindness may result from exposure to concentrated solutions, vapors, mists, or aerosols of diethylenetriamine! *Immediately but gently* flush the eyes with large amounts of water for at least 15 min, occasionally lifting the upper and lower eyelids.
2. **Skin exposure:** Severe burns, skin corrosion, and absorption of toxic amounts may result! *Immediately* remove all contaminated clothing! *Immediately, continuously, and gently* wash skin for at least 15 min. Use soap and water if skin is intact; use only water if skin is not intact.
3. **Inhalation exposure:** Move the victim to fresh air *immediately*. Have the victim blow his or her nose or use a soft tissue to remove particulates or residues from the nostrils.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. **Ingestion exposure:** Take the following steps if diethylenetriamine or any material containing it is ingested:

—Do *not* induce vomiting.

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water. Immediately after rinsing, have the victim drink one cup (8 oz) of fluid and *no more*.

—Do *not* permit the victim to drink milk or carbonated beverages!

—Do *not* permit the victim to drink any fluid if more than 60 min have passed since initial ingestion.

NOTE: These instructions must be followed exactly. Drinking a carbonated beverage or more than one cup of fluid could create enough pressure to perforate already damaged stomach tissue. The tissue-coating action of milk may impede medical assessment of tissue damage. Ingestion of any fluid more than 60 min after initial exposure could further weaken damaged tissue and result in perforation.

5. *Rescue:* Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve diethylenetriamine and lead to worker exposures to this substance:

- Use as a solvent for sulfur, acid gases, and various resins and dyes
- Use as a saponification agent for acidic materials and as a fuel component
- Use as an intermediate in the manufacture of pharmaceuticals

The following methods are effective in controlling worker exposures to diethylenetriamine, depending on the feasibility of implementation:

- Process enclosure
- Local exhaust ventilation
- General dilution ventilation
- Personal protective equipment

Good sources of information on control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. *Engineering design for control of workplace hazards*. New York, NY: McGraw-Hill.
5. Plog BA [1988]. *Fundamentals of industrial hygiene*. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease 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 monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

• Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to diethylenetriamine, a licensed health care professional 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, and respiratory system. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to diethylenetriamine at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history of pulmonary or skin allergies and other findings consistent with diseases of the eyes, skin, or respiratory tract.

- **Periodic medical examinations and biological monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to diethylenetriamine exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of diethylenetriamine on the eyes, skin, or respiratory tract. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for diethylenetriamine.

- **Medical examinations recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job

transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

Determination of a worker's exposure to airborne diethylenetriamine is made using a coated XAD-2 tube (80/40 mg sections, 20/60 mesh); the coating is 10 percent (w/w) 1-naphthylisothiocyanate (NITC). Samples are collected at a maximum flow rate of 0.1 liter/min until a maximum air volume of 10 liters is collected. The sample is then treated with dimethylformamide to extract the diethylenetriamine. Analysis is conducted by high performance liquid chromatography using ultraviolet detection. This method has a sampling and analytical error of 0.10 and is included in the *OSHA Analytical Methods Manual* as OSHA Method No. 60 [OSHA 1985].

PERSONAL HYGIENE

If diethylenetriamine contacts the skin, workers should flush the affected areas immediately with plenty of water for 15 minutes, and then by wash with soap and water.

Clothing contaminated with diethylenetriamine should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of diethylenetriamine, particularly its potential to cause burns of the eyes and skin.

A worker who handles diethylenetriamine should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, applying cosmetics, or using toilet facilities.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where diethylenetriamine or a solution containing diethylenetriamine is handled, processed, or stored.

STORAGE

Diethylenetriamine should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication stan-

standard [29 CFR 1910.1200]. Storage should be in low-fire-risk areas, out of direct sunlight. Outside or detached storage is preferred; inside storage should be in a standard flammable liquids storage room. Containers of diethylenetriamine should be protected from physical damage and should be stored separately from acids, strong oxidizing agents, heat, sparks, and open flame. Because containers that formerly contained diethylenetriamine may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving diethylenetriamine, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
2. Notify safety personnel.
3. Remove all sources of heat and ignition.
4. Ventilate potentially explosive atmospheres.
5. Use water spray to reduce vapors; do not get water inside the container.
6. For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal.
7. For large liquid spills, build dikes far ahead of the spill to contain the diethylenetriamine for later reclamation or disposal.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous quantities, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

• Emergency planning requirements

Diethylenetriamine is not subject to EPA emergency planning requirements under the Superfund

Amendments and Reauthorization Act (SARA) [42 USC 11022].

• Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of diethylenetriamine; there is no reportable quantity for this substance.

• Community right-to-know requirements

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of diethylenetriamine emitted or released from their facility annually.

• Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Although diethylenetriamine is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

• Conditions for respirator use

Good industrial hygiene practice requires that engineer-

ing controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of diethylenetriamine exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

- **Respiratory protection program**

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent any skin contact with diethylenetriamine. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. The following materials have been recommended for use against permeation by diethylenetriamine and may provide protection for periods greater than 8 hours: butyl rubber, neoprene, and Viton. Natural rubber, nitrile rubber, polyvinyl alcohol, and polyvinyl chloride are not recommended.

If diethylenetriamine is dissolved in water or an organic solvent, the permeation properties of both the solvent and

the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or face shields should be worn during operations in which diethylenetriamine might contact the eyes (e.g., through dust particles or splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with diethylenetriamine. Contact lenses should not be worn if the potential exists for diethylenetriamine exposure.

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