OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIETHYL PHTHALATE

INTRODUCTION

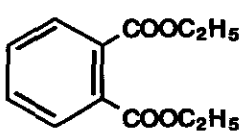
This guideline summarizes pertinent information about diethyl phthalate for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether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**

$C_6H_4(COOC_2H_5)_2$

- **Structure**



- **Synonyms**

1,2-Benzenedicarboxylic acid diethyl ester; Anozol; DEP; diethyl o-phthalate; Estol 1550; ethyl phthalate; Neantine; Palatinol A; phthalic acid, diethyl ester; Phthalol; Placidol E; Solvanol; Unimoll DA.

- **Identifiers**

1. CAS No.: 84-66-2
2. RTECS No.: TI1050000
3. DOT UN: None
4. DOT label: None

- **Appearance and odor**

Diethyl phthalate is a flammable, clear, colorless, oily liquid with a bitter, disagreeable taste and a slight ester odor.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 222.24
2. Boiling point (760 mm Hg): 298°C (568.4°F)
3. Specific gravity (water = 1): 1.12 at 20°C (68°F)
4. Vapor density (air = 1 at boiling point of diethyl phthalate): 7.66
5. Melting point: -40.5°C (-40°F)
6. Vapor pressure at 163°C (325°F): 14 mm Hg
7. Solubility: Insoluble in water; miscible with alcohols,

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ketones, esters, and aromatic hydrocarbons; partly miscible with aliphatic solvents.

8. Evaporation rate (ether = 1): Greater than 300

- **Reactivity**

1. Conditions contributing to instability: Heat, sparks, and open flame

2. Incompatibilities: Contact of diethyl phthalate with strong acids, strong oxidizing agents, nitric acid, permanganates, or water causes a violent reaction.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide, carbon dioxide, and various hydrocarbons) may be released in a fire involving diethyl phthalate.

4. Special precautions: Diethyl phthalate attacks some forms of plastic.

- **Flammability**

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

1. Flash point: 163°C (325°F) (open cup)

2. Autoignition temperature: 457°C (855°F)

3. Flammable limits in air (percent by volume): Lower, 0.7 (@368°F); upper, data not available

4. Extinguishant: Use dry chemical, water spray, alcohol foam, or carbon dioxide to fight fires involving diethyl phthalate. Water spray and foam are effective but may cause frothing. Water may be used to cool fire-exposed containers.

Fires involving diethyl phthalate should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Cool containers from the sides with water until well after the fire is out. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving diethyl phthalate.

EXPOSURE LIMITS

- **OSHA PEL**

The Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure limit (PEL) for diethyl phthalate [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) of 5 mg/m^3 as a TWA for up to a 10-hr workday and a 40-hr workweek [NIOSH 1992].

- **ACGIH TLV**

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned diethyl phthalate a threshold limit value (TLV) of 5 mg/m^3 as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1993].

- **Rationale for limits**

The NIOSH limit is based on mild toxic effects and smaller than normal fetuses in animals associated with diethyl phthalate exposure; the ACGIH limit is based on the risks of polyneuritis and vestibular dysfunction associated with exposure to diethyl phthalate.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Exposure to diethyl phthalate can occur through inhalation, ingestion, and eye or skin contact.

- **Summary of toxicology**

1. *Effects on Animals:* Exposure to diethyl phthalate causes irritation of the eyes, mucous membranes, and skin and may have reproductive effects in animals. Applied to the skin of rats, 50% of a 30- to 40-mg/kg dose of diethyl phthalate was excreted unchanged within 1 week, and the unexcreted dose remained in the area of application [Hathaway et al. 1991]. Instilled into rabbit eyes, diethyl phthalate caused mild irritation. Guinea pigs exposed to a 511-ppm concentration of diethyl phthalate for 6 hr showed signs of mild skin irritation, and cats exposed to a 10-mg/L concentration of this substance for 5 hr showed signs of nasal irritation [Clayton and Clayton 1981]. The oral LD_{50} is 8,600 mg/kg in rats and 6,172 mg/kg in mice [NIOSH 1993]. Male rats and mice given diethyl phthalate by oral administration developed testicular and other reproductive effects [NIOSH 1993; HSDB 1992]. Diethyl phthalate is mutagenic in bacterial test systems [NIOSH 1993].

2. *Effects on Humans:* Diethyl phthalate has irritant effects on the eyes, mucous membranes, and skin of humans and also causes central nervous system effects in exposed workers. Exposure to the heated vapors of diethyl phthalate is reported to have caused transient nose and throat irritation [ACGIH 1991]. In a study of Russian workers exposed to several phthalates (butyl phthalate, higher alkyl phthalates, dioctyl phthalate, diisooctyl phthalate, and benzyl butyl phthalate) at average ambient concentrations of 1.7 to 66 mg/m^3, 32% of workers were found to have signs and symptoms of polyneuritis; 78% of those workers who reported experiencing adverse effects also showed signs of vestibular dysfunction. The toxic effects seen in these workers were related to the duration of exposure and occurred only after 6 or 7 years of exposure to this group of phthalates [ACGIH 1991].

- **Signs and symptoms of exposure**

1. *Acute exposure:* The signs and symptoms of acute exposure to diethyl phthalate include redness and inflammation of eyes and eyelids, runny nose, scratchy throat, headache, dizziness, and nausea.

2. *Chronic exposure:* Chronic exposure to diethyl phthalate may cause signs and symptoms associated with polyneuritis and vestibular dysfunction, including pain, numbness, weakness, and spasms in the arms and legs, dizziness, and nausea.

- **Emergency procedures**

> **WARNING!**
>
> **Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of irritation!**

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Irritation may result from concentrated solutions, vapors, mists, or aerosols of diethyl phthalate. ***Immediately and thoroughly*** flush the eyes with large amounts of water, occasionally lifting the upper and lower eyelids.

2. *Skin exposure:* Irritation may result. ***Immediately and thoroughly*** wash contaminated skin with soap and water.

3. *Inhalation exposure:* Move the victim to fresh air ***immediately.***

   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:* Seek medical attention and take the following steps if a large amount of diethyl phthalate is ingested:

   —Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.

   —Have the victim drink a glass (8 oz) of fluid such as water.

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, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

EXPOSURE SOURCES AND CONTROL METHODS

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

—Use as a solvent for cellulose acetate in the manufacture of varnishes and dopes

—Use as an alcohol denaturant

—Use as a mosquito repellant, plasticizer in solid rocket propellants, wetting agent, and camphor substitute

—Use as a fixative and solvent in perfumes

The following methods are effective in controlling worker exposures to diethyl phthalate, 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 period 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 diethyl phthalate, 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 central nervous system.

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to diethyl phthalate at or below the prescribed exposure limit. The examining 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 and other findings consistent with diseases of the central nervous system.

- **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 diethyl phthalate exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of diethyl phthalate on the central nervous system. 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 diethyl phthalate.

- **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 diethyl phthalate is made using an OSHA Versatile Sampler (OVS-2) with a 13-mm XAD-2 tube (270/140 mg sections, 20/60 mesh) and a glass fiber filter enclosed. Samples are collected at a maximum flow rate of 1.0 liter/min until a maximum air volume of 60 liters is collected. The sample is then treated with carbon disulfide to extract the diethyl phthalate. Analysis is conducted by gas chromatography using a flame ionization detector. This method is described in the OSHA Chemical Information System [OSHA 1990].

PERSONAL HYGIENE

If diethyl phthalate contacts the skin, workers should flush the affected areas immediately with plenty of water for 15 minutes, followed by washing with soap and water.

Clothing contaminated with diethyl phthalate 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 diethyl phthalate, particularly its potential to be irritating to the skin and eyes.

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

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

STORAGE

Diethyl phthalate should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Containers of diethyl phthalate should be protected from physical damage and should be stored separately from acids, bases, strong oxidizing agents, moisture, heat, sparks, and open flame. Because containers that formerly contained diethyl phthalate may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving diethyl phthalate, 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. Notify safety personnel.
2. Ventilate the area of the spill or leak.
3. Take up small spills with paper or other absorbent material for disposal.
4. Build a dike far ahead of the spill area to contain the spill for later reclamation or disposal.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, 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**

  Diethyl phthalate 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**

  A hazardous substance release is defined by EPA as any spilling, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of containers) of hazardous substances. In the event of a release that is above the reportable quantity for that chemical, employers are required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the proper Federal authorities.

The reportable quantity for diethyl phthalate is 1,000 lb. If an amount equal to or greater than this quantity is released within a 24-hour period, in a manner that will expose persons outside the facility, employers are required to do the following:

—Notify the National Response Center *immediately* at (800) 424-8802 or at (202) 426-2675 in Washington, D.C. [40 CFR 302.6].

—Notify the emergency response commission of the State likely to be affected by the release [40 CFR 355.40].

—Notify the community emergency coordinator of the local emergency planning committee (or relevant local emergency response personnel) of any area likely to be affected by the release [40 CFR 355.40].

Community right-to-know requirements

Employers who own or operate facilities in SIC codes 20 to 39 that employ 10 or more workers, and who manufacture 25,000 lb or more or otherwise use 10,000 lb or more of diethyl phthalate per calendar year are required by EPA [40 CFR 372.30] to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of diethyl phthalate 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. Diethyl phthalate is listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.] and has been assigned EPA Hazardous Waste No. U088. It is approved for land disposal as long as the concentration of diethyl phthalate in the waste or treatment residual does not exceed 28-mg/kg. Diethyl phthalate also may be disposed of in an organometallic or organic lab pack that meets the requirements of 40 CFR 264.316 or 265.316.

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 engineering 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 diethyl phthalate 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 about the selection and use of respirators and about 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 gloves and clothing should be worn to prevent

prolonged or repeated skin contact with diethyl phthalate. 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. 4H (PE/EVAL) has been recommended for use against permeation by diethyl phthalate and may provide protection for more than 4 but fewer than 8 hr. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to diethyl phthalate.

If diethyl phthalate is dissolved in 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 diethyl phthalate might contact the eyes (e.g., through splashes of solution). Eyewash fountains and washing facilities should be available within the immediate work area whenever the potential exists for eye or skin contact with diethyl phthalate. Contact lenses should not be worn if the potential exists for diethyl phthalate exposure.

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