

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DI-2-ETHYLHEXYL PHTHALATE (DEHP) POTENTIAL HUMAN CARCINOGEN

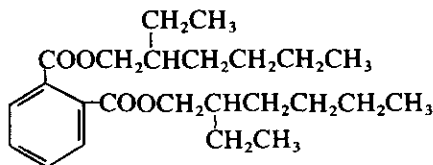
INTRODUCTION

This guideline summarizes pertinent information about di-2-ethylhexyl phthalate (DEHP) 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 Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.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:** C₂₄H₃₈O₄

• **Structure:**



• **Synonyms:** DEHP; 1,2-benzenedicarboxylic acid; bis(2-ethylhexyl) ester; bis(2-ethylhexyl) phthalate; DEHP; phthalic acid; bis(2-ethylhexyl) ester; di-sec octyl phthalate

• **Identifiers:** CAS 117-81-7; RTECS TI0350000; DOT not assigned

• **Appearance and odor:** Clear to slightly colored, oily, odorless liquid

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 390.54
2. Boiling point (at 760 mmHg): 386°C (727°F)
3. Specific gravity (water = 1): 0.9861
4. Vapor density (air = 1 at boiling point of DEHP): 16
5. Melting point: -50°C (-58°F)
6. Vapor pressure: At 20°C (68°F), 0.01 mmHg; at 200°C (392°F), 1.32 mmHg
7. Solubility in water, g/100 g water at 20°C (68°F): 0.005
8. Evaporation rate (butyl acetate = 1): Almost zero

• Reactivity

1. Incompatibilities: Contact with nitrates, strong oxidizers, strong alkalis, or strong acids may cause fire and explosion.
2. Hazardous decomposition products: Toxic vapors and gases

(e.g., carbon monoxide) may be released in a fire involving DEHP.

• Flammability

1. Flash point: 218°C (425°F) (open cup)
2. Autoignition temperature: 390°C (735°F)
3. Flammable limits in air, % by volume: Lower, 0.3 at 245°C (474°F); Upper, Not available
4. Extinguishant: Dry chemical, foam, or carbon dioxide
5. Class IIIB Combustible Liquid (29 CFR 1910.106), Flammability Rating 1 (NFPA)

• Warning properties

1. 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 DEHP is 5 milligrams of DEHP per cubic meter of air (mg/m³) as a time-weighted average (TWA) concentration over an 8-hour workshift. The National Institute for Occupational Safety and Health (NIOSH) recommends that DEHP be controlled and handled as a potential human carcinogen in the workplace, and the recommended exposure limit (REL) is that exposure be reduced to the lowest feasible limit. The use of DEHP in the quantitative fit testing of respirators should be discontinued and replaced with less toxic material such as refined corn oil. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV[®]) is 5 mg/m³ as a TWA for a normal 8-hour workday and a 40-hour workweek; the ACGIH short-term exposure limit (STEL) is 10 mg/m³ (Table 1).

**Table 1.—Occupational exposure limits
for di-2-ethylhexyl phthalate**

	Exposure limits mg/m ³
OSHA PEL TWA	5
NIOSH REL (Ca)*	Lowest feasible limit
ACGIH TLV [®] TWA	5
STEL	10

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

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

HEALTH HAZARD INFORMATION

• Routes of exposure

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

• Summary of toxicology

Effects on animals: Subchronic inhalation of DEHP by rats or mice caused pulmonary irritation, swelling, and congestion of the liver and kidneys, renal cysts, bladder stones, testicular degeneration, increased liver metabolism and liver and kidney weights, and reduced weight gain, renal concentration capacity, blood hematocrit, and cholesterol and triglyceride levels. Chronic inhalation of DEHP by mice or rats produced liver cancer. Oral administration of DEHP to mice or rats on various days during fetal development caused a reduction in implantation rates, an increase in embryoletality, delayed births, and malformations of the skeletal system and the external and central nervous systems. Two-generation reproduction studies in treated rats showed a depression in placental and fetal weights and an increase in liver and kidney weights.

• Signs and symptoms of exposure

Short-term (acute): Exposure to DEHP can cause gastric disturbances and diarrhea. Skin sensitization and irritation of the eyes, skin, and respiratory tract can also occur.

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 individual 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 DEHP, 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, liver, kidneys, gastrointestinal tract, and reproductive and respiratory 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 DEHP. 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 chronic diseases of the liver or skin. The physician should obtain baseline values for liver function tests.

• 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 DEHP. 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 integrity and physiologic function of the eyes, skin, liver, kidneys, gastrointestinal tract, and reproductive and respiratory 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 ATS: standardized questionnaires and lung function tests.

• 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 DEHP may cause 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

• Method

Sampling and analysis may be performed by collecting DEHP vapors with cellulose membrane filters followed by elution with

carbon disulfide and analysis by gas chromatography. Direct-reading devices calibrated to measure DEHP may also be used if available. A detailed sampling and analytical method for DEHP may be found in the *NIOSH Manual of Analytical Methods* (method number 5020).

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 DEHP.

SANITATION

Clothing which is contaminated with DEHP 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 DEHP from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of DEHP'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 DEHP 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 DEHP should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to DEHP may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for di-2-ethylhexyl phthalate (DEHP)

Operations	Controls
During bulk processing and application of plasticized polyvinyl chloride, polyvinylidene chloride, and other vinyl resins	Local exhaust ventilation, personal protective equipment
During hot processing of some plasticized polystyrenes, acrylics, urethanes, polyamides, and other synthetic resins	Local exhaust ventilation, personal protective equipment
During hot compounding plasticization of chlorinated rubbers and nitrile and neoprene rubbers	Local exhaust ventilation, personal protective equipment
During the application of nitrocellulose-based adhesives	Local exhaust ventilation, personal protective equipment
During hot esterification and subsequent steps in the manufacturing of DEHP	Local exhaust ventilation, personal protective equipment

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 DEHP, an eye-wash fountain should be provided within the immediate work area for emergency use.

If DEHP 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 DEHP, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If DEHP gets on the skin, wash it immediately with soap and water. If DEHP 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 DEHP 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 DEHP, absorb on paper towels and place in an appropriate container.
4. Large quantities of liquids containing DEHP may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container.
5. Liquids containing DEHP 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 3).

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 3.—Respiratory protection for di-2-ethylhexyl phthalate (DEHP)

Condition	Minimum respiratory protection*
Any detectable concentration	<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> <p>Any self-contained breathing apparatus with a full facepiece and 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	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	<p>Any air-purifying full facepiece respirator with a high-efficiency particulate filter</p> <p>Any appropriate escape-type self-contained breathing apparatus</p>

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

