Occupational Health Guideline for Dibutyl Phosphate

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $(C_4H_9O)_2(OH)PO$
- Synonyms: Dibutyl acid o-phosphate; di-n-butyl hydrogen phosphate; dibutyl phosphoric acid
- Appearance and odor: Colorless to brown odorless liquid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dibutyl phosphate is 1 part of dibutyl phosphate per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 5 milligrams of dibutyl phosphate per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Dibutyl phosphate can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Dibutyl phosphate may cause irritation of the eyes, nose, throat, and lungs. It may also cause headaches.

2. Long-term Exposure: Repeated or prolonged exposure to dibutyl phosphate may cause irritation of the skin.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to dibutyl phosphate.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to dibutyl phosphate at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from dibutyl phosphate exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of dibutyl phosphate might cause exacerbation of symptoms due to its irritant properties.

—Skin disease: Dibutyl phosphate can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Dibutyl phosphate vapor is a respiratory irritant. In rats the oral LD50 is 3.2 g/kg. Data on effects in humans are sparse; workers exposed to unspecified concentrations of vapor complained of respiratory irritation and headache. It is a moderately strong acid and could be expected to be irritating on contact.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 210
2. Boiling point (760 mm Hg): Higher than 100 C (212 F) (decomposes)
3. Specific gravity (water = 1): 1.06
4. Vapor density (air = 1 at boiling point of dibutyl phosphate): Not applicable
5. Melting point: Data not available
6. Vapor pressure at 20 C (68 F): Much less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• **Reactivity**

1. Conditions contributing to instability: None hazardous

2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as phosphoric acid fume and carbon monoxide) may be released in a fire involving dibutyl phosphate.

4. Special precautions: Liquid dibutyl phosphate will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Flash point: Data not available

2. Autoignition temperature: Data not available

3. Flammable limits in air, % by volume: Data not available

4. Extinguishant: Carbon dioxide, dry chemical, foam

• **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of dibutyl phosphate.

2. Eye Irritation Level: Dibutyl phosphate vapor is not known to be an eye irritant.

3. Evaluation of Warning Properties: Since no quantitative information is available relating warning properties to air concentrations of dibutyl phosphate, this substance is treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

An analytical method for dibutyl phosphate is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with liquid dibutyl phosphate, where skin contact may occur.

• Clothing wet with liquid dibutyl phosphate should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of dibutyl phosphate from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the dibutyl phosphate, the person performing the operation should be informed of dibutyl phosphate's hazardous properties.

• Where exposure of an employee's body to liquid dibutyl phosphate may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

• Non-impervious clothing which becomes contaminated with dibutyl phosphate should be removed promptly and not reworn until the dibutyl phosphate is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid dibutyl phosphate may contact the eyes.

SANITATION

• Skin that becomes contaminated with dibutyl phosphate should be promptly washed or showered with soap or mild detergent and water to remove any dibutyl phosphate.

• Employees who handle liquid dibutyl phosphate should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to dibutyl phosphate may occur and

control methods which may be effective in each case:

Operation	Controls
Use as a catalyst in manufacture of phenolic and urea resins	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in metal separation and extraction	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If liquid dibutyl phosphate gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If liquid dibutyl phosphate gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid dibutyl phosphate soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation is present after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of dibutyl phosphate, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When liquid dibutyl phosphate has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and 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.

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

• If liquid dibutyl phosphate is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Dibutyl phosphate may be disposed of by absorbing in vermiculite, dry sand, earth, or a similar material and disposing in a secured sanitary landfill.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "Dibutyl Phosphate," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

• Christensen, H. E., and Luginbyhl, T. L. (eds.): *NIOSH Toxic Substances List*, 1974 Edition, HEW Publication No. 74-134, 1974.

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• Hawley, G. G. (ed.): *The Condensed Chemical Dictionary* (8th ed. rev.), Van Nostrand Reinhold, New York, 1971.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

RESPIRATORY PROTECTION FOR DIBUTYL PHOSPHATE

Condition	Minimum Respiratory Protection* Required Above 1 ppm
Vapor Concentration	
10 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
50 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
125 ppm or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 125 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates. Any escape self-contained breathing apparatus.

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