

Occupational Health Guideline for Phenyl Ether

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: $(C_6H_5)_2O$
- Synonyms: Diphenyl ether; diphenyl oxide
- Appearance and odor: Colorless solid or liquid with a somewhat disagreeable odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for phenyl ether is 1 part of phenyl ether per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 7 milligrams of phenyl ether per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Phenyl ether can affect the body if it is inhaled, is swallowed, or comes in contact with the eyes or skin.

• Effects of overexposure

1. *Short-term Exposure:* Overexposure to phenyl ether vapor or mist may cause nausea and irritation of the eyes and nose.

2. *Long-term Exposure:* Prolonged or repeated exposure to undiluted phenyl ether liquid 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 phenyl ether.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to phenyl ether 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 phenyl ether exposure.

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

—Liver disease: Although phenyl ether is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although phenyl ether is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

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

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

• Summary of toxicology

Phenyl ether irritates the skin and eyes and has an objectionable odor which may cause nausea. The liquid appears to be low in oral toxicity, but little information on its physiologic effects is available. The acute lethal dose for rats and guinea pigs is 4 g/kg. Animals that survived oral doses of 1 to 2 g/kg showed some injury to the liver, kidneys, spleen, and thyroid. No chronic systemic effects have been reported in humans.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 170.2
2. Boiling point (760 mm Hg): 259 C (498 F)
3. Specific gravity (water = 1): 1.1
4. Vapor density (air = 1 at boiling point of phenyl ether): 5.86
5. Melting point: 27 C (81 F) (maximum value)
6. Vapor pressure at 20 C (68 F): Less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.0021
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving phenyl ether.
4. Special precautions: Phenyl ether will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 115 C (239 F) (closed cup)
2. Autoignition temperature: 620 C (1148 F)
3. Flammable limits in air, % by volume: Lower: 0.8; Upper: 1.5
4. Extinguishant: Foam dry chemical, carbon dioxide

• Warning properties

1. Odor Threshold: May reports an odor threshold for phenyl ether of 0.01 ppm, and Stern reports 0.001 ppm
2. Eye Irritation Level: The *Documentation of TLV's* states that "effects of . . . eye application (of phenyl ether) resemble closely those found for the eutectic mixture with diphenyl; phenyl ether in concentrated, prolonged exposures is somewhat irritating but is not so in dilution." The phenyl ether-diphenyl mixture is known to produce eye irritation at 3-4 ppm (Grant).
3. Evaluation of Warning Properties: Since the odor threshold of phenyl ether is lower than the permissible exposure limit, this substance is treated as a material with good 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

Sampling and analyses may be performed by collection of phenyl ether vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure phenyl ether may be used. An analytical method for phenyl ether is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

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 repeated or prolonged skin contact with liquid or solid phenyl ether.
- Non-impervious clothing which becomes contaminated with liquid or solid phenyl ether should be removed promptly and not reworn until the phenyl ether is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where liquid or solid phenyl ether may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid or solid phenyl ether should be promptly washed or showered with soap or mild detergent and water to remove any phenyl ether.
- Employees who handle liquid or solid phenyl ether 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 phenyl ether may occur and control methods which may be effective in each case:

Operation	Controls
Use as a high-temperature, heat-transfer medium as Dowtherm A, Thermax, Diphyl, and Gilotherm	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as an organic intermediate in organic synthesis resulting in epoxy resins, other phenol-based heat-resistant resins, polysulfone resins, high-temperature lubricants, surfactants, specialty plasticizers, varnishes, phenol-formaldehyde resins, artificial sweeteners, insecticides, preservatives, fire retardants, and adhesives	General dilution ventilation; personal protective equipment
Use as an odorant in the manufacture of soaps and perfumes; use as a flavoring agent in manufacture of food products	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 phenyl ether 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 phenyl ether gets on the skin, promptly wash the contaminated skin using soap or mild detergent together with powdered pumice, borax, or other suitable cleanser. If phenyl ether soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent together with powdered pumice, borax, or other suitable cleansers. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of phenyl ether, 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 phenyl ether has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• 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 phenyl ether is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. For small quantities, absorb or scoop up on paper. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed; however, if this is not practical, collect, dissolve in an appropriate solvent, and atomize in a suitable combustion chamber.

• Waste disposal method:

Phenyl ether may be disposed of by dissolving in appropriate solvent and atomizing in a suitable combustion chamber.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Phenyl Ether," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- Dow Chemical Company: *Material Safety Data Sheet - Diphenyl Oxide, Technical*, Midland, Michigan, 1971.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

- International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1971.
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- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Stern, A. C. (ed.): *Air Pollution* (2nd ed.), Academic Press, New York, 1968.

RESPIRATORY PROTECTION FOR PHENYL ETHER

Condition	Minimum Respiratory Protection* Required Above 1 ppm
Vapor Concentration	
50 ppm or less	<p>Any chemical cartridge respirator with an organic vapor cartridge(s) with a full facepiece and dust and mist filter(s).</p> <p>A gas mask with a chin-style or a front- or back-mounted organic vapor canister with a full facepiece and dust and mist filter.</p> <p>Any supplied-air respirator with a full facepiece, helmet, or hood.</p> <p>Any self-contained breathing apparatus with a full facepiece.</p>
100 ppm or less	<p>A powered air-purifying chemical cartridge respirator with a full facepiece, organic vapor cartridge, and high efficiency particulate filter.</p> <p>A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.</p>
Greater than 100 ppm or entry and escape from unknown concentrations	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p> <p>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.</p>
Fire Fighting	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p>
Escape	<p>Any gas mask providing protection against organic vapors and particulates.</p> <p>Any escape self-contained breathing apparatus.</p>

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