Occupational Health Guideline for Triphenyl 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: $(C_6H_5O)_3PO$
- Synonyms: TPP; phenyl phosphate
- Appearance and odor: Colorless solid with a faint aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for triphenyl phosphate is 3 milligrams of triphenyl phosphate per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Triphenyl phosphate can affect the body if it is inhaled. It may also affect the body if it is swallowed.

- **Effects of overexposure**

Repeated exposure may cause minor changes in the blood enzymes. Animal exposures have produced muscle weakness and paralysis. These effects have not been reported in man.

- **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 triphenyl phosphate.

- **Recommended medical surveillance**

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

—Neuromuscular disorders: Triphenyl phosphate causes neurotoxic effects in animals. Persons with pre-existing neuromuscular disorders may be at increased risk.

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

- **Summary of toxicology**

Triphenyl phosphate is a neurotoxin in animals. When injected in cats it caused delayed paralysis. Two of 6 cats given a single intraperitoneal injection of triphenyl phosphate at 0.1 to 0.4 g/kg developed paralysis after 16 to 18 days. A group of 11 workers exposed to vapor, mist, or dust at an average concentration of 3.5 mg/m^3 and occasionally as high as 40 mg/m^3 for 8 to 10 years exhibited no signs of illness; the only positive finding was a slight but statistically significant reduction in erythrocyte cholinesterase activity. In workers engaged in the manufacture of aryl phosphates (including triphenyl phosphates and up to 20% triorthocresyl phosphate) and exposed to concentrations of aryl phosphates of 0.2 to 3.4 mg/m^3, there was some inhibition of plasma cholinesterase but no correlation of this effect with degree of exposure or with minor gastrointestinal or neuromuscular symptoms. The effects of triphenyl phosphate on the eye have not been reported; application in ethanol to the skin of mice produced no more irritation than was expected from the solvent.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 326
2. Boiling point (760 mm Hg): 370 C (698 F)
3. Specific gravity (water = 1): 1.27
4. Vapor density (air = 1 at boiling point of triphenyl phosphate): Not applicable
5. Melting point: 48.5 C (119 F)
6. Vapor pressure at 20 C (68 F): Very low (0.15 mm

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Hg at 150 C (302 F))

7. Solubility in water, g/100 g water at 20 C (68 F): 0.001

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

• **Reactivity**

1. Conditions contributing to instability: None hazardous

2. Incompatibilities: None

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

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

• **Flammability**

1. Flash point: 220 C (428 F) (closed cup)

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**

Triphenyl phosphate is not known to be an eye irritant.

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 triphenyl phosphate on a filter, followed by extraction with ether, and gas chromatographic analysis. An analytical method for triphenyl 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.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to triphenyl phosphate may occur and control methods which may be effective in each case:

Operation	Controls
Use as a flame-retardant and plasticizer in compounding of chlorinated rubber; use on coatings and adhesives	General dilution ventilation; process enclosure; local exhaust ventilation
Use in hot extrusion, molding, or other bulk forming plasticized cellulose acetates	General dilution ventilation; process enclosure; local exhaust ventilation
Use as a fireproofing agent in manufacture of roofing paper	General dilution ventilation; process enclosure; local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

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

• **Breathing**

If a person breathes in large amounts of triphenyl 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 triphenyl 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 AND DISPOSAL PROCEDURES

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

• If triphenyl phosphate is spilled, the following steps should be taken:

1. Ventilate area of spill.

2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

• Waste disposal methods:

Triphenyl phosphate may be disposed of:

1. By making packages of triphenyl phosphate in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

2. By dissolving triphenyl phosphate in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

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RESPIRATORY PROTECTION FOR TRIPHENYL PHOSPHATE

Condition	Minimum Respiratory Protection* Required Above 3 mg/m³
Particulate Concentration	
15 mg/m³ or less	Any dust and mist respirator, except single-use.
30 mg/m³ or less	Any dust and mist respirator, except single-use or quarter-mask respirator. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
150 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
1500 mg/m³ or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 1500 mg/m³ 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.

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