

# Occupational Health Guideline for Triorthocresyl 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:  $(\text{CH}_3\text{C}_6\text{H}_4)_3\text{PO}$
- Synonyms: O-tritolyol phosphate; TCP; TOCP
- Appearance and odor: Colorless, odorless liquid.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for triorthocresyl phosphate is 0.1 milligram of triorthocresyl phosphate per cubic meter of air ( $\text{mg}/\text{m}^3$ ) averaged over an eight-hour work shift.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Triorthocresyl phosphate can affect the body if it is inhaled, comes in contact with the eyes or skin, or swallowed. It may enter the body through the skin.

### • Effects of overexposure

Triorthocresyl phosphate may cause paralysis of the lower arms and legs if it is swallowed, inhaled (as a fog mist, or aerosol), or absorbed through the skin. Nausea, vomiting, diarrhea, and abdominal pain may occur shortly after exposure. These symptoms disappear and are followed, after a symptom-free period of 3 to 28 days, by the paralytic effect.

### • 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 triorthocresyl phosphate.

### • Recommended medical surveillance

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

#### 1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the peripheral and central nervous systems should be stressed.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

#### • Summary of toxicology

Triorthocresyl phosphate (TOCP) causes peripheral neuropathy with flaccid paralysis of the distal muscles of the upper and lower extremities, followed in some cases by a spastic paralysis. In affected cats and hens, extensive damage is observed in the spinal cord and sciatic nerves; damage to the myelin sheath and Schwann cells is secondary to the destructive lesion in the axon, which starts at the distal end of the longer axons. Thousands of people have been poisoned by the accidental ingestion of TOCP in contaminated foods and beverages; reports of intoxication from occupational exposure are rare. Shortly after ingestion there may be nausea, vomiting, diarrhea, and abdominal pain. After a symptom-free interval of 3 to 28 days, most patients complain of sharp, cramplike pains in the calf muscles, and some of numbness and tingling in the feet and sometimes the hands. Within a few hours there is increasing weakness of the legs and feet, progressing to bilateral footdrop. After an interval of another 10 days, weakness of the fingers and wristdrop develop, but the paralysis is not usually as severe as occurs in the feet and legs; this process does not extend above the elbows; the thigh muscles are infrequently involved. Sensory changes, if they occur, are minor. With severe intoxication, lesions of the anterior horn cells and the pyramidal

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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.

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tracts may also occur. Muscular weakness may increase over a period of several weeks or months; recovery may take months or years, and in 25 to 30% of cases permanent residual effects remain, usually confined to the lower limbs. Fatalities are rare and occur principally in those who have taken large quantities of TOCP in a short period of time; autopsy of six human cases revealed involvement of anterior horn cells and demyelination of nerve cells. The lethal dose for humans by ingestion is about 1.0 g/kg; severe paralysis has been produced by ingestion of 6 to 7 mg/kg. In workers engaged in the manufacture of aryl phosphates (including up to 20% TOCP) and exposed to concentrations of aryl phosphates at 0.2 to 3.4 mg/m<sup>3</sup>, there was some inhibition of plasma cholinesterase but no correlation of this effect with degree of exposure or with minor gastrointestinal or neuromuscular symptoms. No effects on the eyes or skin have been reported; TOCP is readily absorbed through the skin without local irritant effects.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 368
2. Boiling point (760 mm Hg): 410 C (770 F) (decomposes)
3. Specific gravity (water = 1): 1.17
4. Vapor density (air = 1 at boiling point of triorthocresyl phosphate): Not applicable
5. Melting point: -33 C (-27 F)
6. Vapor pressure at 20 C (68 F): Very low (0.02 mm Hg at 150 C (302 F))
7. Solubility in water, g/100 g water at 20 C (68 F): 0.00003
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 triorthocresyl phosphate.
4. Special precautions: Liquid triorthocresyl phosphate will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Flash point: 225 C (437 F) (closed cup)
2. Autoignition temperature: 385 C (725 F)
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Foam, carbon dioxide, dry chemical

### • Warning properties

Triorthocresyl phosphate (TOCP) 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 triorthocresyl phosphate on a filter, followed by extraction with ether, and gas chromatographic analysis. An analytical method for triorthocresyl 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 repeated or prolonged skin contact with liquid triorthocresyl phosphate.

• Clothing contaminated with triorthocresyl phosphate should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of triorthocresyl phosphate from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the triorthocresyl phosphate, the person

performing the operation should be informed of triorthocresyl phosphate's hazardous properties.

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

## SANITATION

- Skin that becomes contaminated with triorthocresyl phosphate should be promptly washed or showered with soap or mild detergent and water to remove any triorthocresyl phosphate.
- Eating and smoking should not be permitted in areas where liquid triorthocresyl phosphate is handled, processed, or stored.
- Employees who handle liquid triorthocresyl 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 triorthocresyl phosphate may occur and control methods which may be effective in each case:

Operation	Controls
Use as a flame retarder and plasticizer in chlorinated rubber, nitrile rubber and resins; use in hot extrusion, molding, or bulk forming of plasticized polyvinyl chloride	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment
Use in coatings and adhesives based on plasticized cellulose esters and alkyds	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment
Use as a gasoline additive to control pre-ignition	Personal protective equipment
Use as a hydraulic fluid and a heat exchange medium	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

## Operation

Use as a synthetic lubricant; as a waterproofing agent; as a primary component of adhesives for air filter media; use as a solvent mixture for nitrocellulose and other natural resins

Use as an extraction solvent in recovery of phenol from gas-plant effluents and coke-oven waste waters

Use in grinding media for pigments; use as an intermediate in synthesis of pharmaceuticals

## Controls

Personal protective equipment

Personal protective equipment

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.

### • Eye Exposure

If liquid triorthocresyl phosphate gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If liquid triorthocresyl phosphate gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If liquid triorthocresyl phosphate soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.

### • Breathing

If a person breathes in large amounts of triorthocresyl 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 triorthocresyl 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 triorthocresyl phosphate is spilled or leaked, the following steps should be taken:
  1. Ventilate area of spill or leak.
  2. For small quantities, absorb on paper towels. 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 collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
- Waste disposal methods:

Liquid triorthocresyl phosphate may be disposed of:

  1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
  2. By atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

## REFERENCES

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## RESPIRATORY PROTECTION FOR TRIORTHOCRESYL PHOSPHATE

Condition	Minimum Respiratory Protection* Required Above 0.1 mg/m <sup>3</sup>
Particulate Concentration	
0.5 mg/m <sup>3</sup> or less	Any dust and mist respirator, except single-use.
1 mg/m <sup>3</sup> 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.
5 mg/m <sup>3</sup> 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.
40 mg/m <sup>3</sup> 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 40 mg/m <sup>3</sup> 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 dust and mist respirator, except single-use. Any escape self-contained breathing apparatus.

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

