

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** TRIPHENYL PHOSPHATE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TRIPHENYL PHOSPHATE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance TRIPHENYL PHOSPHATE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of triphenyl phosphate not in excess of 3 milligrams per cubic meter (mg/M3) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for triphenyl phosphate.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which triphenyl phosphate is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of triphenyl phosphate at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of triphenyl phosphate.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to triphenyl phosphate;

(ii) Any measurements of triphenyl phosphate taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to triphenyl phosphate; and

(IV) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to triphenyl phosphate at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to triphenyl phosphate at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to triphenyl phosphate at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to triphenyl phosphate above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee—who is found to be exposed to triphenyl phosphate above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to triphenyl phosphate below the action level, the employer may terminate measurement for the employee.

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(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	$\pm 25\%$
At or below permissible exposure and above the action level	$\pm 35\%$

At or below the action level $\pm 50\%$

(d) Compliance. (1) No employee shall be exposed to triphenyl phosphate above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of triphenyl phosphate shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of triphenyl phosphate.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

— (i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

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(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of triphenyl phosphate to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR TRIPHENYL PHOSPHATE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
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 respirator or quarter mask.
	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.

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Fire Fighting Self-contained breathing apparatus with a full facepiece
 operated in pressure-demand or other positive pressure
 mode.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for triphenyl phosphate.

(2) For the purpose of compliance with § 1910.157, triphenyl phosphate is classified as a Class B fire hazard.

(3) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(4) Sources of ignition such as smoking or open flames are prohibited where triphenyl phosphate presents a fire or explosion hazard.

(f) Personal protective equipment. Reserved.

(g) Spills and disposal. In the event that triphenyl phosphate is spilled, the employer shall immediately provide available ventilation and then clean up the spill.

(h) Sanitation. Reserved.

(i) Training and information. (1) Each employer who has a workplace in which triphenyl phosphate is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to triphenyl phosphate above the action level, or employees who work where a spill of triphenyl phosphate may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for triphenyl phosphate (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to triphenyl phosphate.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to triphenyl phosphate which are listed in Appendix A of the section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to triphenyl phosphate.

— (j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to airborne concentrations of triphenyl phosphate at or above

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the action level information as to whether such employee has a history of neuromuscular disorders.

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of the medical condition listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to triphenyl phosphate which are listed in Appendix A which the employee suspects are caused by exposure to triphenyl phosphate.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for triphenyl phosphate;

(ii) A description of the affected employee's duties as they relate to his exposure to triphenyl phosphate;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to triphenyl phosphate or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to triphenyl phosphate including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to triphenyl phosphate.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to triphenyl phosphate or airborne concentrations of triphenyl phosphate in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to triphenyl phosphate.

(9) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such

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refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(10) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to triphenyl phosphate.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to triphenyl phosphate which are being monitored;

(C) Sampling and analytical method used and evidence of their accuracy;

(D) Number, duration, and results of samples taken; and

(E) Name and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

— (A) The name of the employee;

(B) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(C) Any employee medical complaints relative to exposure to triphenyl phosphate;

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(D) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section.

(E) Physician's written opinion; and

(F) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of and for one year after termination of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Each employee or former employee shall have access to the exposure determination and exposure measurement records required to be maintained by this section which indicate his own exposure to triphenyl phosphate.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give each employee or his representative an opportunity to observe any measurement of his exposure to triphenyl phosphate which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to triphenyl phosphate requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of triphenyl phosphate that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR TRIPHENYL PHOSPHATE

I. SUBSTANCE IDENTIFICATION

A. Substance: Triphenyl phosphate

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B. Permissible Exposure: 3 milligrams of triphenyl phosphate per cubic meter of air (mg/M3) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless solid with a faint aromatic odor

II. HEALTH HAZARD DATA

A. Ways in which the chemical affects your body: Triphenyl phosphate can affect your body if you inhale it. It may also affect your body if you swallow it.

B. Effects of Overexposure:

1. Exposure: 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.

2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to triphenyl phosphate.

III. EMERGENCY FIRST AID PROCEDURES

A. Breathing: If you or any other 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.

B. Swallowing: When triphenyl phosphate has been swallowed, 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.

C. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to triphenyl phosphate. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you can smell triphenyl phosphate while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience

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difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: Not applicable.

C. Eye Protection: Not applicable.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Triphenyl phosphate is a combustible solid. At elevated temperatures its vapors can form explosive mixtures with air.

B. Triphenyl phosphate must be stored in tightly closed containers in a cool, well ventilated area.

C. Sources of ignition such as smoking and open flames are prohibited wherever triphenyl phosphate is handled, used or stored in a manner that could create a potential fire or explosive hazard.

D. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.

E. Ask your supervisor where triphenyl phosphate is used in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for triphenyl phosphate. In addition, your employer must instruct you in the safe use of triphenyl phosphate, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to triphenyl phosphate. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and the actions which are being taken to reduce your exposure.

C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of one year following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.

D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES

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FOR TRIPHENYL PHOSPHATE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: TPP; phenyl phosphate
2. Formula: $(C_6H_5O)_3PO$
3. Molecular weight: 326.3

B. Physical Data

1. Boiling point (760 mm Hg): 370 C (698 F)
2. Specific gravity (water = 1): 1.27
3. Vapor density (air = 1 at boiling point of triphenyl phosphate): Not applicable
4. Melting point: 48.5 C (119 F)
5. Vapor pressure at 20 C (68 F): Very low (0.15 mm Hg at 150 C)
6. Solubility in water, % by weight at 20 C (68 F): 0.001
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Colorless solid with a faint aromatic odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

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. Extinguishing media: Carbon dioxide, dry chemical, foam
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Triphenyl phosphate is a combustible solid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where triphenyl phosphate is used, handled or stored in a manner that could create a potential fire or explosion hazard. When triphenyl phosphate burns, a heavy sooty smoke forms.
7. For purposes of complying with the requirements of 29 CFR 1910.106, liquid triphenyl phosphate is classified as a Class IIIB combustible liquid.

B. 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.

III. SPILL AND DISPOSAL PROCEDURES

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

1. Ventilate area of spill.

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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.
- B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
- C. 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.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average eight-hour exposure may be determined from a single eight-hour sample or 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). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of the particulates using a high efficiency membrane filter with subsequent chemical analyses. The method of measurement must determine the concentration of triphenyl phosphate to plus or minus 35%.
- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of triphenyl phosphate to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set P" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure

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that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store triphenyl phosphate in tightly closed containers in a cool, well ventilated area.
- B. Employers should advise employees of all areas and operations where exposure to triphenyl phosphate could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to triphenyl phosphate is likely to occur are: During its production; during its use as a flame-retardent plasticizer for cellulosic resins and hot-melt adhesives; during hot spray application of coatings and adhesives, during hot extrusion, molding, or other bulk forming; during its production; and during its use as a fireproofing agent.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. 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/M3, and occasionally as high as 40 mg/M3, 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 percent triorthocresyl phosphate) and exposed to concentrations of aryl phosphates of 0.2 to 3.4 mg/M3, 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.

III. SIGNS AND SYMPTOMS

By analogy to effects caused in animals, it has the potential to cause delayed paralysis.

IV. SPECIAL TESTS

None in common usage. RBC cholinesterase may show a slight reduction on the average in groups of exposed workers.

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V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation if indicated.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Triphenyl phosphate apparently is of low toxicity. By analogy to effects caused in animals it has the potential to cause delayed paralysis but there is no evidence of this in humans. It is important that the physician become familiar with plant operating conditions in which exposure to triphenyl phosphate occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

Routine medical histories and physical examinations are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from triphenyl phosphate exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Neuromuscular disorders -- Triphenyl phosphate causes neurotoxic effects in animals. Persons with preexisting neuromuscular disorders may be at increased risk.

C. PERIODIC EXAMINATIONS

Routine Periodic Examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Triphenyl Phosphate," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 272.
2. Hygienic Guide Series: "Triphenyl Phosphate," American Industrial Hygiene Association Journal, 31:388-390, 1970.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1915-1925.

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4. Sutton, W.L., et al: "Studies on the Industrial Hygiene and Toxicology of Triphenyl Phosphate," Archives of Environmental Health, 1:45-58, 1960.

5. Tabershaw, I.R., et al: "Manufacture of Tricresyl Phosphate and Other Alkyl Phenyl Phosphates: An Industrial Hygiene Study. I. Environmental Factors," A.M.A. Archives of Industrial Health, 15:537-540, 1957.

6. Tabershaw, I.R. and M. Kleinfeld: "Manufacture of Tricresyl Phosphate and Other Alkyl Phenyl Phosphates: An Industrial Hygiene Study. II. Clinical Effects of Tricresyl Phosphate," A.M.A. Archives of Industrial Health, 15:541-544, 1957.

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REFERENCES AND SOURCES
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- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: American Industrial Hygiene Association, "Hygienic Guide Series"
Skin: American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values for Substances in Workroom Air"
Patty, "Industrial Hygiene and Toxicology"
American Industrial Hygiene Association, "Hygienic Guide Series"
Hjorth, N., "Contact Dermatitis from Cellulose Acetate Film"
Ingestion: Deichmann and Gerarde, "Toxicology of Drugs and Chemicals"
Gleason, "Clinical Toxicology of Commercial Products"
Patty, "Industrial Hygiene and Toxicology"
Sutton, "Studies on the Industrial Hygiene and Toxicology of Triphenyl Phosphate."
American Industrial Hygiene Association, "Hygienic Guide Series"

COMMENTS

Eye Classification: 0

Output statement numbers: None

Exceptions: None

A search of literature sources failed to reveal any cases of eye splash contact nor any toxicological data on eye effects of this compound.

The Hygienic Guide Series states, "the effects of eye contact are unknown."

Since it is nowhere even mentioned that the dust in air is irritating to the eyes, it is concluded that justification does not exist for any classification other than zero.

Skin - Classification: 0

Output statement numbers: None

Exceptions: None

According to the ACGIH, "TPP is poorly absorbed through the skin and does not produce skin irritation."

Patty notes that this compound is "not a skin irritant; not absorbed through skin appreciably."

The Hygienic Guide Series concludes that "there is no evidence that TPP is absorbed through the skin. It is not a skin irritant."

Recent studies by Hjorth, however, note that there is "cross-sensitization between TCP and TPP." By performing routine patch tests in Denmark with pieces of acetate film plasticized with 7-10% TPP, he found that "four cases analyzed showed positive reaction" to sensitivity to TPP. It is further noted however, "among 23,192 patients tested between 1950-1962, 15 patients had shown positive reactions to discs, a remarkably low figure in view of the numerable sources of contact with TPP and TCP."

Triphenyl phosphate has a flash point of 428 degrees F.

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Its melting point is 119 degrees F and it is 0.001% soluble in water.

Skin contact with this compound would not appear to be hazardous. The incidence of sensitization must be considered to be negligible. For these reasons, the substance is assigned a classification of zero.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

Deichmann and Gerarde report that "TPP has a low order of acute toxicity for rats, mice and guinea pigs. It produces delayed generalized illness and paralysis in cats. When administered orally, it is absorbed slowly."

Gleason reports that this compound is a "neurotoxic substance like TCP" but it is more potent in cats than in man. It "causes a delayed peripheral neuritis involving motor neurons, resulting in a flaccid paralysis, particularly of the distal muscles."

According to Patty, it causes "paralysis and inhibition (weak) of cholinesterase" but it is clear from a study by M. I. Smith that TPP "presents almost no industrial hazard as contrasted to TOCP."

In his paper Sutton states, "the toxicity of TPP was investigated by M. I. Smith as part of his studies on the etiology of the 'ginger paralysis' epidemic of 1930. He and his associates found that TPP produced a generalized delayed paralysis in cats and monkeys. These animals showed demyelination in the spinal cord and peripheral nerves which closely resembled that found in TOTP-poisoned animals. However, TPP, unlike TOTP did not cause paralysis in chickens and rabbits." Sutton further states that "TPP poisoning has never been recorded in man."

The Hygienic Guide Series states that "this route of entry is not considered an industrial hazard. In man, effects have not been demonstrated."

Patty gives the oral LD50 in the rat as greater than 6.4 gm/kg and in the cat at greater than 2.0 gm/kg.

Since this compound has a "low order of toxicity" and this route of exposure is "not considered an industrial hazard," a classification of zero is concluded to be appropriate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)

Monsanto Company, Material Safety Data Sheet (Mons)

Stauffer Chemical Co., Product Safety Information, Phosflex TPP (Stauff)

"Lange's Handbook of Chemistry," 11th edition (Lange)

- Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 4, p. 657 and Vol. 15, p. 721 and 764 (K-O)

Sources of data items used:

I.	A.	1.	Synonyms: Stauff, Lange
		2.	Formula: Lange
		3.	Molecular weight: Lange

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- B.
 - 1. Boiling point: Mons, Stauff
 - 2. Specific gravity: Mons
 - 3. Vapor density: None
 - 4. Melting point: Stauff
 - 5. Vapor pressure: Mons
 - 6. Solubility in water: Mons
 - 7. Evaporation rate: None
 - 8. Appearance and odor: Mons
- II. A.
 - 1. Flash point: NFPA-325M
 - 2. Autoignition temperature: Data not available
 - 3. Flammable limits: Not applicable
 - 4. Extinguishing media: Mons
 - 5. Special fire fighting procedures; Mons, ADL
 - 6. Unusual fire and explosion hazards: Stauff, Mons, NFPA-325M
- B.
 - 1. Conditions contributing to instability: ADL
 - 2. Incompatibilities: None
 - 3. Hazardous decomposition products: ADL
 - 4. Special precautions: ADL
- III. A. Steps if released or spilled: Stauff, Mons
- C. Waste disposal method: Mons
- V. Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

Sources used in the preparation of this document include:

- "Documentation of Threshold Limit Values," American Conference of Governmental Industrial Hygienists, 1971 (ACGIH)
- Gleason, M. N. et al., "Studies of the Industrial Hygiene and Toxicology of Triphenyl Phosphate," Archives of Environmental Health, Vol. I, July 1960 (Sutton)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley and Sons, Inc., 2nd edition, 1968 (K-O)
- "Merck Index of Chemicals and Drugs," Merck and Company, Rahway, New Jersey, 8th edition, 1968 (Merck)
- Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)
- Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California, January 1971 (CEH)
- Sutton, W. L. et al., "Studies of the Industrial Hygiene and Toxicology of Triphenyl Phosphate," Archives of Environmental Health, Vol. I, July 1960 (Sutton)

References for Specific Use/Exposure

- 1. AIHA, Gleason, CEH, K-O
- 2. AIHA, Gleason, CEH, K-O, Contractor estimates
- 3. AIHA, Gleason, CEH, K-O, Contractor estimates
- 4. Sutton
- 5. Merck

References for Specific Control Methods

AIHA, ACGIH and Patty were the references used for all of the Specific Control Methods.

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RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Triphenyl phosphate

D. O. L. STANDARD: 3 mg/M3

Eye Irritation Level: Triphenyl phosphate is not known to be an eye irritant.

IDLH: There is no evidence in the available toxicological information of an IDLH concentration for TPP. The AIHA Hygienic Guides state that "concentrations of triphenyl phosphate aerosol high enough to produce acute toxic effects in man have not been achieved." For the purposes of this standard, respirators have been selected on the basis of the protection factor afforded by each device. It is recognized, however, that for some substances for which there does not appear to exist a concentration immediately dangerous to life and health, the determination of allowable respiratory protection based on protection factors may result in the selection of a concentration which is not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only those respirators allowed for use above IDLH concentrations are permitted for use in concentrations exceeding 500 times the permissible exposure.

Other Toxicological Information: The AIHA Hygienic Guides state that "concentrations of triphenyl phosphate aerosol high enough to produce acute toxic effects in man have not been achieved. In animals (mice) a minor but statistically significant change in whole blood cholinesterase was noted after a 2-hour exposure at 757 mg/M3 but for an unexplained reason it was not noted in mice exposed 4 hours at the same concentration."

The Documentation of TLV's notes that "there was no evidence of adverse clinical effects in men exposed for as long as ten years to TPP vapor, mist, and dust at a weighted average air concentration of 3.5 mg/M3. (The Hygienic Guides state that prior to this exposure these men had been exposed to a concentration of 14 to 40 mg/M3) . . . The threshold limit of 3 mg/M3 is based on medically supervised human experience."

Patty states that from an investigation involving the toxicological and industrial hygiene aspects of TPP, "it seems clear . . . that triphenyl phosphate presents almost no industrial hazard as contrasted to tri-o-cresyl phosphate."

Deichmann and Gerarde, however, note that TPP "produces delayed generalized illness and paralysis in cats." In Sutton's investigation, to which Deichmann and Gerarde refer, one of the 2 cats which developed delayed paralysis had been given a dose of 0.2 g/kg by intraperitoneal injection and the other cat had been given 0.4 g/kg.

VAPOR PRESSURE AT 150 C: 0.15 mm Hg

SATURATED CONCENTRATION AT 150 C: Approximately 197 ppm (2620 mg/M3)

Reference: Sutton, W. L., Terhaar, C. J., Miller, F. A., Scherberger, R. F., Riley, E. C. Roudabush, R. L. and Fassett, D. W., "Arch. Envr. Health,"

1:33 (July 1960)

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TRIPHENYL PHOSPHATE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of aerosol during use as a flame - retardant and plasticizer in the compounding of chlorinated rubber, nitrile rubber, neoprene rubber and resins such as polyvinyl acetate, cellulose nitrate, cellulose acetate, alkyds, cellulose acetate-butyrate and phenolics	A	General dilution ventilation; process enclosure; local exhaust ventilation
2.	Inhalation of aerosol during hot spray application of coatings and adhesives based on plasticized polyvinyl acetate, cellulose nitrate, cellulose acetate, cellulose acetate - butyrate and alkyds	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
3.	Inhalation of aerosol during hot extrusion, molding or other bulk forming of plasticized cellulose acetate, cellulose acetate - butyrate, alkyds and phenolics	A	General dilution ventilation; process enclosure; local exhaust ventilation
4.	Inhalation of aerosol, vapor and dust during the production of triphenyl phosphate by the reaction of phenol and phosphorus oxychloride	A	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices)
5.	Inhalation of aerosol during use as a fireproofing agent in the manufacture of roofing paper	A	General dilution ventilation; process enclosure; local exhaust ventilation

A -- Inhalation

B -- Skin and eye contact resulting in localized irritation

C -- Ingestion

D -- Skin contact resulting in absorption and subsequent systemic poisoning

----- JES2 JOB STATISTICS -----

1,105 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

