

Occupational Health Guideline for Parathion

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: $(C_2H_5O)_2PSOC_6H_4NO_2$
- Synonyms: O,O-Diethyl-O,p-nitrophenyl phosphorothioate; ethyl parathion
- Appearance and odor: Yellow to dark brown liquid with a characteristic odor, like garlic.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for parathion is 0.1 milligram of parathion per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be reduced to $0.05 mg/m^3$. The NIOSH Criteria Document for Parathion should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

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

• Effects of overexposure

1. Short-term Exposure: After inhalation of parathion, breathing and eye effects are the first to appear. These include tightness of the chest, wheezing, a bluish discoloration of the skin, small pupils, aching in and behind the eyes, blurring of vision, tearing, runny nose, headache, and watering of the mouth. After swallowing parathion, loss of appetite, nausea, vomiting, abdominal cramps and diarrhea may appear within two hours.

After skin absorption, sweating and twitching in the area of absorption may occur, usually within 15 minutes to four hours. With severe intoxication by all routes, in addition to the above symptoms, weakness, generalized twitching, and paralysis may occur and breathing may stop. In addition, dizziness, confusion, staggering, slurred speech, generalized sweating, irregular or slow heartbeat, convulsions and coma may occur.

2. Long-term Exposure: Repeated exposure to parathion may make a person more susceptible to the effects of this and related chemicals. Repeated exposure to concentrations which are too small to produce symptoms after a single exposure may result in the onset of symptoms.

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 parathion.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to parathion 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. Persons with a history of reduced pulmonary function, convulsive disorders, or recent exposure to anticholinesterase agents would be expected to be at increased risk from exposure. Examination of the respiratory system, nervous system, cardiovascular system, eyes, and attention to the cholinesterase levels in the blood should be stressed. The skin should be examined for evidence of chronic disorders.

—Cholinesterase determination: Parathion causes depressed levels of activity of cholinesterase in the serum and erythrocytes. The cholinesterase activity in the serum and erythrocytes should be determined by using

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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medically acceptable biochemical tests prior to any new period of exposure.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis, with the exception of the cholinesterase determination. This test should be performed at four-week intervals, except for those employees in areas which may involve intense exposure, for whom the test should be repeated weekly. If any employee works with parathion more than 12 hours per day, he should be tested every 3 weeks. Employees should also be tested at any time overexposure is suspected or signs or symptoms of toxicity appear. Any employee having a 30 to 40% decrease in cholinesterase should be removed from exposure and placed under medical observation.

• **Summary of toxicology**

Parathion is an anticholinesterase agent; absorption may occur from inhalation of the vapor or mist, from skin absorption of the liquid, or from ingestion. Signs and symptoms of overexposure are caused by the inactivation of the enzyme cholinesterase, which results in the accumulation of acetylcholine at synapses in the nervous system and skeletal and smooth muscle secretory glands. The sequence of the development of systemic effects varies with the route of entry. The onset of signs and symptoms may occur promptly or may be delayed for up to 12 hours. After inhalation respiratory and ocular effects are the first to appear, often within a few minutes after exposure. Respiratory effects include tightness in the chest and wheezing due to bronchoconstriction and excessive bronchial secretion; laryngeal spasms and excessive salivation may add to the respiratory distress; cyanosis may also occur. Ocular effects include miosis, aching in and behind the eyes (attributed to ciliary spasm), blurring of distant vision, tearing, rhinorrhea, and frontal headache. After ingestion, gastrointestinal effects, such as anorexia, nausea, vomiting, abdominal cramps, and diarrhea appear within 15 minutes to 2 hours. After skin absorption, localized sweating and muscular fasciculations in the immediate area occur usually within 15 minutes to 4 hours; skin absorption is somewhat greater at higher ambient temperatures, and is increased by the presence of dermatitis. With severe intoxication by all routes, an excess of acetylcholine at the neuromuscular junctions of skeletal muscle causes weakness aggravated by exertion, involuntary twitchings, fasciculations, and eventually paralysis; the most serious consequence is paralysis of the respiratory muscles. Effects on the central nervous system include giddiness, confusion, ataxia, slurred speech, Cheyne-Stokes respiration, convulsions, coma, and loss of reflexes. The blood pressure may fall to low levels, and cardiac irregularities including complete heart block may occur; these effects may sometimes be reversed by establishing adequate pulmonary ventilation. Complete symptomatic recovery usually occurs within 1 week; increased susceptibility to the effects of anticholinesterase agents persists for weeks after exposure. Daily exposure to concentrations which are insuff-

icient to produce symptoms following a single exposure may result in the onset of symptoms. Continued daily exposure may be followed by increasingly severe effects. A few drops of technical parathion in the eyes of animals have produced lacrimation and moderate conjunctivitis. The minimum lethal oral dose of parathion for humans has been estimated to range from less than 10 mg up to 120 mg. In a study of 115 workers exposed to parathion under varying conditions, the majority excreted significant amounts of p-nitrophenol (a metabolite of parathion) in the urine, while only those with heavier exposures had a measurable decrease in blood cholinesterase.

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 291.3
2. Boiling point (760 mm Hg): 375 C (707 F) (calculated)
3. Specific gravity (water = 1): 1.27
4. Vapor density (air = 1 at boiling point of parathion): Not applicable
5. Melting point: 6 C (43 F) (pure grade); 0 C (32 F) (technical grade)
6. Vapor pressure at 20 C (68 F): 0.0004 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): .00002
8. Evaporation rate (butyl acetate = 1): Not applicable

• **Reactivity**

1. Conditions contributing to instability: Temperatures above 100 C (212 F) may cause decomposition so that containers burst.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen, phosphorus, sulfur, and carbon monoxide) may be released when parathion decomposes.
4. Special precautions: Parathion will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Not combustible

• **Warning properties**

1. Odor Threshold: The odor threshold of parathion is 0.04 ppm (American Society of Testing Materials Bulletin).
2. Eye Irritation Level: The AIHA *Hygienic Guide* states that "a few drops of technical parathion in animals has produced immediate blinking, lacrimation, and moderate conjunctivitis. Pupil constriction was also observed, with a return to normal size and reaction the following day. Eye contact with 1% aqueous suspensions of 15% wettable powders did not show evidence of irritation or other obvious reaction."
3. Evaluation of Warning Properties: Since the odor threshold of parathion is so low, parathion 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 parathion using a filter with subsequent recovery with iso-octane and gas chromatographic analysis. A detailed analytical method for parathion may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161, under the title "NIOSH Analytical Methods for Set T" (order number PB 262 404).

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 parathion.

• If employees' clothing has had any possibility of being contaminated with parathion, employees should change into uncontaminated clothing before leaving the work premises.

• Where there is any possibility of exposure of an employee's body to parathion, 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 parathion should be removed immediately and not reworn until the parathion is removed from the clothing.

• Clothing which has had any possibility of being contaminated with parathion should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of parathion from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the parathion, the person performing the operation should be informed of parathion's hazardous properties.

• Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid parathion contacting the eyes.

• Where there is any possibility that employees' eyes may be exposed to parathion, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

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

• Workers subject to skin contact with parathion should wash with soap or mild detergent and water any areas of the body which may have contacted parathion at the end of each work day.

• Eating and smoking should not be permitted in areas where parathion is handled, processed, or stored.

• Employees who handle parathion 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 parathion may occur and control methods which may be effective in each case:

| Operation | Controls |
|---|---|
| Application as a pesticide on agricultural crops, vegetables and ornamentals and on agricultural premises | Personal protective equipment |
| Formulation for use as an insecticide | Process enclosure; personal protective equipment |
| Manufacture of parathion | Process enclosure; 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 parathion or parathion mists get 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 parathion or parathion mists get on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If parathion or parathion mists penetrate 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 parathion, 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 parathion 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 parathion 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:

Parathion may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR PARATHION

| Condition | Minimum Respiratory Protection* Required Above 0.1 mg/m ³ |
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| Particulate or Vapor Concentration | |
| 1 mg/m ³ or less | Any chemical cartridge respirator with an organic vapor cartridge(s) and dust, fume, and mist filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator. Any self-contained breathing apparatus. |
| 5 mg/m ³ or less | A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust, fume, and mist filter(s), including pesticide respirators which meet the requirements of this class. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust, fume, and mist filter, including pesticide respirators which meet the requirements of this class. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. |
| 20 mg/m ³ or less | A powered air-purifying respirator with an organic vapor cartridge and high efficiency particulate filter, including pesticide respirators which meet the requirements of this class. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode. |
| Greater than 20 mg/m ³ ** 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.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of parathion; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 20 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.