

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** EPN ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for EPN

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 EPN.

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 EPN (o-ethyl-o-p-nitrophenyl thionobenzene phosphonate) not in excess of 0.5 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 EPN averaged over an eight-hour work shift.

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

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

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

(ii) Any measurements of EPN taken;

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

(iv) Date of initial determination, work being performed at the time, location within work site, and employees considered.

(3) If the employer determines that any employee may be exposed to EPN above the permissible exposure, 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 EPN above the action level, the employer shall:

(i) Identify all employees who may be exposed above the permissible level; and

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

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

(6) If an employee exposure measurement reveals that an employee is exposed to EPN 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 EPN above the permissible exposure. The employee shall also be notified of the results of the exposure measurements and of the corrective action being taken to reduce the exposure to below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to EPN 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 EPN above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of EPN 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 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 local exhaust is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity or static pressure, 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 EPN.

(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 not feasible; or

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

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

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(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 EPN

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION*
Particulate or Vapor Concentration	
5 mg/M3 or less	Any supplied-air respirator. Any self-contained breathing apparatus.
25 mg/M3 or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
50 mg/M3 or less	A Type C supplied-air respirator operated in pressure - demand or other positive pressure or continuous-flow mode.
Greater than 50 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.
Escape	Any gas mask providing protection against organic vapors and particulates (including pesticide respirators which meet the requirements of this class). Any escape self-contained breathing apparatus.

* Use of supplied-air suits may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of EPN. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitation and potential life endangering characteristics of supplied-air suits. Where supplied-air

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suits are used above a concentration which may be immediately dangerous to life and health (50 mg/M3), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

(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 EPN.

(2) EPN shall be stored so as not to come in contact with strong oxidizers.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent any possibility of skin contact with EPN or liquids containing EPN. Face shields shall comply with § 1910.133 (a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that employees whose clothing has had any possibility of being contaminated with EPN or liquids containing EPN change into uncontaminated clothing before leaving the work premises.

(3) Employers shall ensure that clothing which has had any possibility of being contaminated with EPN is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of EPN from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the EPN, the employer shall inform the person performing the operation of the hazardous properties of EPN.

(4) Where there is any possibility of exposure of an employee's body to EPN or liquids containing EPN, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(5) Employers shall ensure that non-impervious clothing which becomes contaminated with EPN be removed immediately and not reworn until the EPN is removed from the clothing.

(6) Employers shall provide and ensure that employees use safety goggles which comply with § 1910.133 (a)(2)-(a)(6) where there is any possibility of EPN or liquids containing EPN contacting the eyes.

(7) Where there is any possibility that an employee's eyes may be exposed to EPN or liquids containing EPN, employers shall provide an eye-wash facility within the immediate work area for emergency use.

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

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with EPN immediately wash or shower with soap or mild detergent and water to remove any EPN from the skin.

(2) Employers shall ensure that all employees subject to skin contact with EPN or liquids containing EPN wash with soap or mild detergent and water any areas of the body which may have contacted EPN at the end of each workday.

(3) Employers shall ensure that employees do not eat or smoke in areas where EPN or liquids containing EPN are handled, processed or stored.

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(4) Employers shall ensure that employees who handle EPN or liquids containing EPN wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which EPN 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 EPN above the action level without regard to the use of respirators, or employees who may have any possibility of skin contact or eye contact with EPN or liquids containing EPN, or employees who work where a spill of EPN may occur, shall annually:

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

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

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

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

(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) Preplacement medical examination. The employer shall make available to each employee who is exposed, or will be exposed, to airborne concentrations of EPN above the action level, without regard to the use of respirators, or employees who may have skin contact or eye contact with EPN or liquids containing EPN, a preplacement medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, skin, nervous system, and heart;

(ii) A determination of cholinesterase activity in serum and red blood cells.

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of EPN above the action level, without regard to the use of respirators, or employees who may have skin contact or eye contact with EPN or liquids containing EPN, a periodic medical examination which must include the following:

(i) A medical history and physical examination with emphasis on the lungs, skin, nervous system and heart to be performed annually from the date of the employee's first exposure;

(ii) A determination of cholinesterase activity in serum and red blood cells to be performed quarterly from the date of the employee's first exposure.

(4) Alternative medical procedures. If the examining physician chooses to use alternative medical procedures to those specified in paragraphs (j)(2) and (j)(3) of this section, the employer may accept such alternative medical procedures as meeting the requirements of this section provided that the employer:

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(i) Obtains a statement from the examining physician setting forth the alternative medical procedures, the rationale for substitution, and evidence that they will be equally effective;

(ii) Informs each exposed worker of the fact that alternative medical procedures to those required in paragraphs (j)(2) and (j)(3) of this section are to be made available.

(5) Interim medical examination. The employer shall provide an interim medical examination including a determination of cholinesterase levels for the employee if the employee informs the employer of any of the signs or symptoms of exposure to EPN which are listed in Appendix A or at anytime overexposure to EPN is suspected.

(6) Informing the physician. The employer shall provide to the physician performing any medical examination required by this section the following information:

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

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

(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 level; and

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

(7) Where a medical examination is required by paragraphs (j)(2), (j)(3), or (j)(5) of this section, following such examination the employer shall obtain from the examining physician a written opinion which conforms with paragraph (j)(8) of this section.

(8) Physician's written opinion. (i) The physician's written opinion by the examining physician shall specifically state:

(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 EPN;

(B) Any recommended limitations upon the employee's exposure to EPN, 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 the employee's employment.

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

(9) Results of tests. Where a preplacement or periodic medical examination is required by paragraphs (j)(2) or (j)(3) of this section, following such examination the employer shall obtain from the examining physician for inclusion in the employee's medical record:

(i) A recording of the results of the cholinesterase determination;

(ii) Where alternative medical procedures have been performed in accordance with paragraph (j)(4) of this section, a recording of such alternative procedures.

(10) No employee shall be exposed to EPN in such a way as would put the employee at increased risk of material impairment of his health from such

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exposure. The employer shall base this decision on any information available including the physician's written opinion.

(11) No medical procedure which would be performed pursuant to paragraphs (j)(2) or (j)(3) of this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(12) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risk involved by refusal to be examined.

(13) The employer shall provide emergency medical treatment for any employee injured through exposure to EPN.

(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 EPN.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to EPN 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, social security number 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 and social security number 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 and social security number of the employee;

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(B) Results of tests required by paragraph (j)(2) and (j)(3) of this section and results of any tests conducted pursuant to paragraphs (j)(4) of this section;

(C) Any employee medical complaints relative to exposure to EPN;

(D) A copy of information provided to the physician pursuant to paragraph (j)(6)(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 five years 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 EPN.

(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 EPN which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to EPN 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 EPN that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for EPN is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent that the information supplements this regulation for EPN, it is advisory in nature.

APPENDIX A

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SUBSTANCE SAFETY DATA SHEET
FOR EPN

I. SUBSTANCE IDENTIFICATION

- A. Substance: EPN (O-ethyl-O-p-nitrophenyl thionobenzenephosphonate)
- B. Permissible Exposure: 0.5 milligram of EPN per cubic meter of air (mg/M3) averaged over an eight-hour work shift.
- C. Appearance: Yellow solid or brown liquid.

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: EPN can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it. It may enter your body through your skin.
- B. Effects of Overexposure:
 - 1. Short-term Exposure: After inhalation of EPN, 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 EPN, 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 all the above symptoms, weakness, generalized twitching and paralysis may occur and breathing may stop. In addition, dizziness, confusion, staggering, slurred speech, generalized sweating, slow heartbeat, convulsions and coma may occur.
 - 2. Long term Exposure: Repeated exposure to EPN may make you 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: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to EPN.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If EPN or liquids or mists containing EPN get into your eyes, wash your 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.
- B. Skin Exposure: If EPN or liquids or mists containing EPN get on your skin, immediately wash the contaminated skin using soap or mild detergent and water. If EPN or liquids or mist containing EPN penetrate through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately.
- C. Breathing: If you or any other person breathes in large amounts of EPN move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration.

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Keep the affected person warm and at rest. Get medical attention as soon as possible.

- D. Swallowing: When EPN or liquids containing EPN have 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.
- E. 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 emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to EPN. 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 their use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. Protective Suits: In some work situations the wearing of supplied-air suits or other impervious coverings such as acid suits may be necessary. Your employer should instruct you in their proper use and operation.
- C. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent any possibility of skin contact with EPN or liquids containing EPN. Replace or repair any impervious clothing that has developed leaks.
- D. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquids containing EPN contacting your eyes. You must wear dust-resistant safety goggles where there is any possibility of solid EPN contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. EPN must be stored in tightly closed containers in a well ventilated area away from strong oxidizers.
- B. If your work clothing has had any possibility of being contaminated with EPN or liquids containing EPN, you must change into uncontaminated clothing before leaving the work premises.
- C. You must immediately remove any non-impervious clothing that becomes contaminated with EPN and this clothing must not be reworn until the EPN is removed from the clothing.

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- D. If your skin becomes contaminated with EPN, you must immediately wash or shower with soap or mild detergent and water to remove any EPN from your skin.
- E. If you are subject to skin contact with EPN or liquids containing EPN, at the end of each workday you must wash with soap or mild detergent and water any areas of the body which may have contacted EPN.
- F. You must not eat or smoke in areas where EPN or liquids containing EPN are handled, processed or stored.
- G. If you handle EPN or liquids containing EPN, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- H. Quick drenching facilities and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them.
- I. Ask your supervisor where EPN 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 EPN. In addition, your employer must instruct you in the safe use of EPN, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to EPN. 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 five years 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.

NOTE: The information contained in the following appendix for EPN is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent that the information supplements this regulation for EPN, it is advisory in nature.

APPENDIX B

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SUBSTANCE TECHNICAL GUIDELINES
FOR EPN

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: O-ethyl O-p-nitrophenyl thionobenzenephosphonate;
O-ethyl O-p-nitrophenyl benzenephonothioate
2. Formula: $(4\text{-NO}_2\text{C}_6\text{H}_4\text{O})(\text{C}_2\text{H}_5\text{O})\text{C}_6\text{H}_5\text{PS}$ or $\text{C}_{14}\text{H}_{14}\text{NO}_4\text{PS}$
3. Molecular weight: 323.3

B. Physical Data

1. Boiling point (760 mm Hg): Data not available
2. Specific gravity (water = 1): 1.27
3. Vapor density (air = 1 at boiling point of EPN): Not applicable
4. Melting point: 36 C (97 F)
5. Vapor pressure at 100 C (212 F): 0.0003 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Insoluble
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance: Yellow solid or brown liquid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Not combustible

B. Reactivity

1. Conditions contributing to instability: None.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of sulfur and nitrogen, phosphoric acid mist, and carbon monoxide) may be released when EPN decomposes.
4. Special precautions: Liquid EPN will attack some forms of plastics, rubber and coatings.

III. SPILL AND DISPOSAL PROCEDURES

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

1. Ventilate area of spill.
2. Cover with soda ash, mix and spray with water. Place in a container of water and allow to stand for two days, then neutralize with 6 molar HCl.

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

C. Waste disposal methods: EPN may be disposed of in sealed containers in a secured sanitary landfill.

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 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 (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by collection of the particulates and vapors using a high

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efficiency membrane filter followed by an adsorption tube with subsequent chemical analysis of both the filter and adsorption tube. Detector tubes certified by NIOSH under 42 CFR part 84 or other direct-reading devices calibrated to measure EPN may be used. The method of measurement must determine the concentration of EPN 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 above. More than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Samples should be collected as described in 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 EPN 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 T" (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 that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store EPN in tightly closed containers in a well ventilated area.
- B. Use of supplied-air suits or other impervious coverings (such as acid suits) may be necessary to prevent skin absorption from EPN. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.
- C. Employers should advise employees of all areas and operations where their exposure to EPN could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to EPN is likely to occur are: During its production and its use as an insecticide, pesticide and acaricide.

NOTE: The information contained in the following appendix for EPN is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent the information supplements this regulation for EPN, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

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I. ROUTE OF ENTRY

Inhalation; skin absorption; ingestion.

II. TOXICOLOGY

EPN (O-ethyl-O-p-nitrophenyl thionobenzene phosphate) is an anticholinesterase agent; absorption may occur from inhalation of the dust or mist; from skin absorption of solutions, 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, skeletal and smooth muscle, and 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 insufficient to produce symptoms following a single exposure may result in the onset of symptoms. Continued daily exposure may be followed by increasingly severe effects. In animals, EPN has produced a demyelination syndrome.

III. SIGNS AND SYMPTOMS

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Miosis, aching in and behind eyes, blurring of distant vision, tearing, rhinorrhea, frontal headache; tightness in the chest, wheezing, laryngeal spasm, excessive salivation, cyanosis; anorexia, nausea, vomiting, abdominal cramps, diarrhea; localized sweating; muscular fasciculations, weakness aggravated by exertion, involuntary twitchings, paralysis; giddiness, confusion, ataxia, slurred speech, Cheyne-Stokes respiration, convulsion, coma, loss of reflexes; low blood pressure, cardiac irregularities including complete heart block; skin and eye irritation from direct contact.

IV. SPECIAL TESTS

Serial measurements of cholinesterase activity in plasma and erythrocytes are helpful in monitoring an individual for effects of chronic exposure. They are also helpful in confirming diagnosis of intoxication. Although these values show considerable variation in the normal population, they will usually be depressed well below the normal range before any symptoms due to systemic anticholinesterase intoxication are evident. Such values do not reflect the activities of the corresponding enzymes in the nervous system or other tissues.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Observe for convulsions and initiate appropriate treatment. The physician should become thoroughly familiar with the use of atropine sulfate and 2-PAM (and other cholinesterase reactivators) which are antidotes. In very severe cases, the order of treatment should be as follows: 1) Artificial resuscitation, if required; 2) Atropine sulfate, 2 to 4 mg (1/30 to 1/15 grain) intravenously. Repeat at 5 to 10 minute intervals until signs of atropinization appear (dry, flushed skin and tachycardia as high as 140 per minute); 3) 2-PAM, slowly, intravenously, 1 g for adults; 4) Symptomatic treatment. In the more usual case, proceed as follows: 1) Atropine sulfate, 1 to 2 mg (1/60 to 1/30 grain), if symptoms appear. If excessive secretions occur, keep the patient fully atropinized. Give atropine sulfate every hour up to 25 to 50 mg in a day; 2) 2-PAM, slowly, intravenously, 1 g for adults, if the patient fails to respond satisfactorily to atropine sulfate. Neither atropine nor 2-PAM should be taken by workers as a prophylactic measure.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of EPN are caused by its anticholinesterase properties. In occupational cases, illness is frequently delayed several hours. Relatively incapacitating symptoms of nausea, cramps, discomfort in the chest, and muscular twitchings often follow initial giddiness, blurred vision, and headache only after a period of 2 to 8 hours. Miosis may appear late and mydriasis may

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actually be present as a reaction to the discomfort and apprehension associated with poisoning. Skin absorption is an important route of entry. It is important that the physician become familiar with plant operating conditions in which exposure to EPN 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

The following medical procedures must be made available to each employee who is exposed to EPN:

1. A complete history and physical examination -- The purpose is to detect preexisting 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 and attention to the cholinesterase levels in the blood should be stressed. The skin should be examined for evidence of chronic disorder.
2. Cholinesterase determination -- EPN causes depressed levels of activity of cholinesterase in the serum and erythrocytes. The cholinesterase activity in the serum and erythrocytes shall be determined by using medically acceptable biochemical tests prior to any new period of exposure.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis, with the exception of the cholinesterase determination which shall be performed quarterly or at any time overexposure is suspected or signs or symptoms of toxicity occur.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "EPN (O-Ethyl-O-p-Nitrophenyl Thionobenzene Phosphonate)," Documentation of the Threshold Limit Values for Substances in Workroom Air, (3d ed., 2d printing), Cincinnati, 1974, p. 99.
2. Hayes, W.J., Jr.: Clinical Handbook on Economic Poisons, Emergency Information for Treating Poisoning, U.S. Public Health Service Publication No. 476, U.S. Government Printing Office, Washington, D.C., 1963, pp. 12-23.
3. Goodman, Louis S. and Alfred Gilman: The Pharmacological Basis of Therapeutics (5d ed.), The Macmillan Publishing Company, New York, 1975, pp. 456-466.

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4. Koelle, George B., Ed.: Handbuch der Experimentellen Pharmakologie, Vol. 15 - Cholinesterases and Anticholinesterase Agents, Springer-Verlag, Berlin, 1963, pp. 989-1027.

5. Patty, Frank A.: Industrial Hygiene and Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1935-1940, 1945-1946.

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REFERENCES AND SOURCES

EPN

1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: Comm. of Penn., "Hygienic Information Guide," No. 68; Hamilton and Hardy, "Industrial Toxicology;" Deichmann and Gerarde "Toxicology of Drugs and Chemicals"
- Skin: Patty, "Industrial Hygiene and Toxicology;" Hamilton and Hardy, "Industrial Toxicology;" Comm. of Penn., "Hygienic Information Guide," No. 68; International Labour Office, "Encyclopedia of Occupational Health and Safety;" Spencer, "Guide to the Chemicals Used in Crop Protection;" Christensen, "NIOSH Toxic Substances List;" Spector, "Handbook of Toxicology;"
- Ingestion: American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limits Values for Substances in Workroom Air;" Patty, "Industrial Hygiene and Toxicology;" Spector, "Handbook of Toxicology;" International Labour Office, "Encyclopedia of Occupational Health and Safety;" Comm. of Penn., "Hygienic Information Guides," No. 68; Christensen, "NIOSH Toxic Substances List"

COMMENTS

Eye - Classifications: 1 and 5

Output statement numbers: 9 and 11 combined, 13

Exceptions: None

According to Hygienic Information Guide No. 68, "the eye is a particularly vulnerable portal of entry . . ." for EPN.

While referring to organophosphorus insecticides in general, Hamilton and Hardy report "manifestations of absorption tend to occur most rapidly . . . after massive exposure directly to the eye. With massive exposure or direct application of compounds to the conjunctival epithelium, the onset of symptoms is almost instantaneous, and death may follow within minutes."

Deichmann and Gerarde note, "constriction of the pupil may be seen, but this is not a constant sign of poisoning, nor is it an indication of its severity. It may be caused by the local effect of spray mist in the eye."

Since the eye is a particularly vulnerable portal of entry for EPN and the compound is very readily absorbed through unbroken skin, it is concluded that classifications of 1 and 5 are warranted.

Skin - Classifications: 1 and 5

Output statement numbers: 1, 5a, 6, 8a, 14g, 14i, 15, 20a

Exceptions: None

According to Patty, "the most important route of industrial exposure to the organic phosphates is by accidental spillage on the skin. Percutaneous absorption frequently is unnoticed since dermal irritation rarely occurs . . ."

Hamilton and Hardy list EPN as among the most dangerous organophosphorus compounds. They further note that "organo-

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phosphorus insecticides are absorbed by the skin, but the rate tends to be slow except in the presence of dermatitis and high ambient temperatures. Moderate effects of acute absorption may occur within . . . two to three hours of cutaneous exposure. Complete restoration of blood cholinesterase levels may require three months. A greater degree of absorption produces vomiting, hyperistalsis with cramps and diarrhea, increased salivation and lacrimation, profuse sweating, pallor, dyspnea, and wheezing. Central nervous system manifestations may include anxiety, emotional aberration, insomnia or somnolence, headache, tremor, and intellectual deterioration. Death in cases of heavy exposure is usually related to respiratory collapse."

According to the Hygienic Information Guide No. 68, the substance "may produce severe toxic symptoms and possible death." A route of entry is "through the unbroken skin. Lack of odor and warning signs, as well as delayed onset of symptoms, make EPN a dangerous material to work with. Repeated exposure may be increasingly hazardous."

The ILO reports that the toxicity of organophosphorus pesticides depends on their mode of entry. "If entry is through the skin, the first symptom is often muscular twitching at the place of contact. The clinical picture usually develops over a longer period of time and . . . damage to the central nervous system may be less pronounced. In the majority of organophosphorus pesticides the cumulative effect is decidedly weak."

Spencer gives the toxic dose to rabbits by skin application as 30 - 35 mg/kg. Christensen lists the skin LD50 as 23 mg/kg for the rat.

Spector states "it is postulated that a rapid conversion of EPN in vivo yields a substance highly inhibitory of choline esterase, the inhibition being of the second order and irreversible."

EPN has a melting point of 97 degrees F. Its vapor pressure at 20 degrees C is very low and it is insoluble in water.

Since inhibition of choline esterase may be irreversible, since repeated exposure may be "increasingly hazardous," and since the compound is very readily absorbed through the skin, it is concluded that classifications of 1 and 5 are warranted for this substance.

Ingestion - Classifications: 2 and 5

Output statement numbers: 5a, 19, 20a

Exceptions: None

The ACGIH reports "the oral LD50 of EPN for small animals was found to range from 7 - 33 mg/kg and 75 ppm in the diet for two years were found to have no effect on rats by Hodge and co-workers. Lehman reported that a dietary level of 60 ppm for one year (equivalent to 210 mg/man/day) produced no effect in rats, while 180 ppm (equivalent to 630 mg/man/day) produced tissue damage to the zona glomerulosa of the adrenal cortex

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in 52 weeks. Rider found no effect on blood cholinesterase nor development of symptoms when volunteers ingested 6 mg EPN daily for 44 days or later when 8 mg malathion was added to the diet (6 mg EPN - 8 mg malathion) for an additional 44 days." The principal effect of EPN is that of cholinesterase inhibition and it appears to be about 1/5 as toxic as parathion.

Patty reports the "acute oral LD50 for pure EPN is 42 and 14 mg/kg for male and female rats, respectively; for the technical materials, values of 28 to 33 and 7 to 13 mg/kg are given by Hodge et al."

Patty further adds, "in 2-year chronic feeding studies in rats, doses of 150 ppm for males and 75 ppm for females produced no effect. Doses of 2.0 mg/kg/day were administered to male and female dogs for 1 year without effect."

Spector lists the oral LD50 for the mouse, female rat, and guinea pig as 45.5, 14.5, 91.0 and 79.0 mg/kg respectively. Thienes and Haley estimate the fatal human dose to be 0.3 gm.

According to the ILO, "organophosphorus pesticides are rapidly absorbed into the body through the mucous membrane of the digestive tract . . . and penetrate into the cardiovascular system and the different organs."

The Hygienic Information Guide No. 68 reports "the principal mode of action of EPN is the inactivation of cholinesterase." Toxic "manifestations of EPN include headache, giddiness, blurred vision, constriction of the pupils, nausea, cramps, diarrhea and sweating. The signs and symptoms of severe poisoning by EPN are a feeling of a tightness of the chest, difficult breathing, bluish skin coloration, muscular twitching, convulsions, fluid in the lungs and coma."

Christensen lists the LD50 for the rat as 8 mg/kg, for the pigeon as 6 mg/kg, quail as 5 mg/kg and duck as 3 mg/kg.

Spector also reports "it is postulated that a rapid conversion of EPN in vivo yields a substance highly inhibitory of choline esterase, the inhibition being of the second order and irreversible."

Classifications of 1 and 5 are concluded to be most appropriate for this extremely toxic substance.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

E. I. duPont de Nemours and Co., Technical Data Sheet and Product Label (duP)
Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, vol. 11,
p. 703 (K-0)

Sources of data items used:

- I. A. 1. Synonyms: duP
- 2. Formula: duP
- 3. Molecular weight: duP
- B. 1. Boiling point: Data not available
- 2. Specific gravity: K-0
- 3. Vapor density: Not applicable

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- 4. Melting point: duP
- 5. Vapor pressure: duP, K-O
- 6. Solubility in water: duP, K-O
- 7. Evaporation rate: Not applicable
- 8. Appearance and odor: duP, K-O
- II. A. 1. Flammability: duP
- B. 1. Conditions contributing to instability: ADL
- 2. Incompatibilities: ADL
- 3. Hazardous decomposition products: ADL
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: duP, ADL
- C. Waste disposal method: ADL, duP
- V. Miscellaneous precautions: duP

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- American Conference of Governmental Industrial Hygienists, "Documentation of Threshold Limit Values for Substances in Workroom Air," 3rd edition, Cincinnati, 1971 (ACGIH)
- Deichmann, William, B., "Safe Handling and Use of Organic Phosphate Pesticides," Industrial Medicine and Surgery, p.267 - 74, April 1967 (Deichmann)
- "EPA Compendium of Registered Pesticides," Environmental Protection Agency, Vol. III, Part 2 and 3, 1972 (EPA)
- Hamilton, A. and Hardy, H. L., "Industrial Toxicology," Publishing Sciences Group, Inc., 3rd edition, 1974 (Hamilton and Hardy)
- "Hygienic Information Guides," Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Occupational Health (Penn)
- International Labour Office, "Encyclopedia of Occupational Health and Safety," McGraw-Hill Book Company, New York, 1971 (ILO)
- Milby, Thomas H., "Prevention and Management of Organo Phosphate Poisoning," Journal of the American Medical Association, 216:13, p. 2131 - 33, June 28, 1971 (Milby)
- Patty, F. A., "Industrial Hygiene and Toxicology," Vol. 2, second revised edition, Interscience Publishers, New York, 1963 (Patty)
- Plunkett, E. R., "Handbook of Industrial Toxicology," Chemical Publishing Company, Inc., New York, 1966 (Plunkett)
- Sax, N. I., "Dangerous Properties of Industrial Materials," 3rd edition, Reinhold Publishing Co., 1968 (Sax)
- Stecher, P. G. - editor, "The Merck Index," eighth edition, Merck and Co., Inc., New Jersey, 1968 (Stecher)
- Spector, W. S. (Vol. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S., (Vol. V) - editors, "Handbook of Toxicology," Saunders, Philadelphia, 1956 - 1959 (Spector)
- Spencer, E. Y., "Guide to the Chemicals Used in Crop Protection," sixth edition (publication 1093), Research Branch Agriculture Canada, 1973 (Spencer)
- Stolman, A. - editor, "Progress in Chemical Toxicology," Vol. 2 and 4, Academic Press, New York, 1965 and 1969 (Stolman)
- References for Specific Use/Exposure
- 1. ILO, Spencer, Penn, Deichmann, EPA
- 2. Sax, ACGIH, Spector, Stolman, Patty, ILO, Stecher, EPA, Hamilton and Hardy, Plunkett, Spencer, Milby

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3. Penn, Spencer, Deichmann, Milby
4. Penn, ILO, Milby

References for Specific Control Methods

1. Penn, ILO, EPA, Spencer, Deichmann
2. ILO, Milby, Plunkett, Hamilton and Hardy
3. Penn, Spencer, ILO, Deichmann, Milby
4. Deichmann, ILO

RESPIRATORY TABLE DOCUMENTATION

SUBSTANCE: EPN

D. O. L. STANDARD: 0.5 mg/M3

WARNING PROPERTIES:

Odor Threshold: There is no quantitative information available concerning the odor threshold of EPN.

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

Evaluation of Warning Properties: Since there is no quantitative information available relating warning properties to air concentrations of EPN, EPN is treated as a material with poor warning properties. The Hygienic Information Guides for EPN of the Commonwealth of Pennsylvania's Occupational Health Division state that the "lack of odor and warning signs, as well as the delayed onset of symptoms, make EPN a dangerous material to work with." Gas sorbent respiratory equipment is not permitted.

IDLH: 50 mg/M3

Basis for IDLH Value: There are no acute inhalation toxicity data available upon which to base the IDLH for EPN. The chosen IDLH, therefore, has been estimated from the mouse intraperitoneal LD50 of 8 mg/kg. grams given by Thienes and Haley.

Other Toxicological Information: The Hygienic Information Guide for EPN of the Commonwealth of Pennsylvania's Division of Occupational Health contains the following information: EPN is an organic phosphate compound and may produce severe toxic symptoms and possible death. The route of entry of EPN into the body may be by absorption through the unbroken skin, inhalation or by ingestion. The eye is a particularly vulnerable portal of entry . . . Repeated exposure may be increasingly hazardous. The principal mode of action of EPN is the inactivation of cholinesterase, a body of enzyme necessary for proper nerve function. The toxic manifestations of EPN include headache, giddiness, blurred vision, constriction of the pupils, nausea, cramps, diarrhea and sweating. The signs and symptoms of severe poisoning by EPN are a feeling of a tightness of the chest, difficult breathing, bluish skin coloration, muscular twitching, convulsions, fluid in the lungs and coma."

The Documentation of TLV's states that "the oral LD50 of EPN for small animals was found to range from 7 - 33 mg/kg and 75 ppm in the diet for two years were found to have no effect on rats by Hodge and co-workers. Lehman reported that a dietary level of 60 ppm for one year (equivalent to 210 mg/man/day) produced no effect in rats, while 180 ppm (equivalent to 630 mg/man/day) produced tissue damage to the zona glomerulosa of the adrenal cortex in 52 weeks. Rider found no effect on blood cholinesterase nor development of symptoms when volunteers ingested 6 mg EPN daily for 44 days, or later when 8 mg malathion was added to the diet (6 mg EPN - 8 mg malathion)

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for an additional 44 days. Because the principal effect of EPN is that of cholinesterase inhibition, and it appears to be about 1/5 as toxic as the well-documented parathion, its threshold limit has been set at 0.5 mg/M3."

The NIOSH Toxic Substances List gives rat, skin absorption LD50 of 23 mg/kg.

VAPOR PRESSURE AT 100 C: 0.03 mm Hg

SATURATED CONCENTRATION AT 100 C: Approximately 39.5 ppm or 521 mg/M3

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of dust, mist, fume and skin contact with liquid during formulation (mixing - wettable powder, dust, emulsified concentrate, granules) for use as a pesticide (insecticide, acaricide)	A,D	Process enclosure; dust collection; personal protective equipment (gloves, goggles, respiratory protective devices, protective clothing); general dilution ventilation (natural); good personal hygiene practice
2.	Inhalation of dust, mist, fume and skin contact with liquid during application (spraying, dusting) for use as a pesticide (insecticide, acaricide) on agriculture crops, vegetables, fruit trees and ornamentals	A,D	Material substitution; personal protective equipment (gloves, goggles, respiratory protective devices, protective clothing); good personal hygiene practice
3.	Inhalation of dust, mist, fume and skin contact with liquid during manufacture (reaction of benzene thiophosphoryl chloride with alcohol and pyridine in benzene at room temperature, followed by reaction with sodium p-nitrophenoxide in boiling chlorobenzene) for use as a pesticide (insecticide, acaricide)	A,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing, respiratory protective devices); good personal hygiene practice
4.	Inhalation of dust, mist, fume and skin contact with liquid during processing (storage, packaging, transportation) for use as a pesticide (insecticide, acaricide)	A,D	Proper labeling; general dilution ventilation; local exhaust ventilation; good personal hygiene practice

- A -- Inhalation
B -- Skin and eye contact resulting in localized irritation
C -- Ingestion
D -- Skin contact resulting in

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absorption and subsequent
systemic poisoning

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