

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** N-PROPYL NITRATE ***

11

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

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 N-PROPYL NITRATE.

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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of n-propyl nitrate not in excess of 25 parts per million (ppm) (110 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 n-propyl nitrate.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which n-propyl nitrate is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of n-propyl nitrate 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 n-propyl nitrate.

(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 n-propyl nitrate;

(ii) Any measurements of n-propyl nitrate taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to n-propyl nitrate; 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 n-propyl nitrate 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 n-propyl nitrate 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 n-propyl nitrate 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 n-propyl nitrate 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 n-propyl nitrate 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 n-propyl nitrate below the action level, the employer may terminate measurement for the employee.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(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 n-propyl nitrate above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of n-propyl nitrate 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 n-propyl nitrate.

(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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of n-propyl nitrate 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 N-PROPYL NITRATE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
250 ppm or less	Any chemical cartridge respirator with a cartridge providing protection against n-propyl nitrate.* Any supplied-air respirator. Any self-contained breathing apparatus.
1000 ppm or less	Any chemical cartridge respirator with a full facepiece providing protection against n-propyl nitrate.* Any gas mask with a chin style or front- or back-mounted canister providing protection against n-propyl nitrate.* Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
2000 ppm or less	A Type C supplied-air respirator operated in pressure - demand or other positive pressure or continuous-flow mode.
Greater than 2000 ppm 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 escape self-contained breathing apparatus.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

Any gas mask providing protection against n-propyl
nitrate.*

*n-Propyl nitrate is a strong oxidizer and should be kept away from combustible materials. Some cartridges and canisters may contain activated charcoal and shall not be used for protection against n-propyl nitrate. Only non-combustible sorbents are allowed.

(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 n-propyl nitrate.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of n-propyl nitrate shall be Class I, Group B.

(3) For the purpose of compliance with § 1910.157, n-propyl nitrate is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of n-propyl nitrate shall be Class I, Group B.

(5) For the purpose of compliance with § 1910.106, liquid n-propyl nitrate is classified as a Class IB flammable liquid.

(6) Where a fan is located in ductwork and where n-propyl nitrate is present in the ductwork in concentrations greater than 5000 ppm (approximately 25% of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(7) Sources of ignition such as smoking or open flames are prohibited where n-propyl nitrate presents a fire or explosion hazard.

(8) n-Propyl nitrate shall be stored so as not to come in contact with strong oxidizers and combustible materials.

(9) Non-sparking tools shall be used to open and close containers of n-propyl nitrate.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid n-propyl nitrate. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing wet with liquid n-propyl nitrate is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of n-propyl nitrate from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the n-propyl nitrate, the employer shall inform the person performing the operation of the hazardous properties of n-propyl nitrate.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(3) Employers shall ensure that non-impervious clothing which becomes contaminated with n-propyl nitrate be removed promptly and that any clothing which becomes wet with liquid n-propyl nitrate be removed immediately. Such clothing shall not be reworn until the n-propyl nitrate is removed from the clothing.

(4) Employers shall provide and ensure that employees use which comply with § 1910.133(a)(2)-(a)(6) where liquid n-propyl nitrate may contact the eyes.

(g) Spills and disposal. (1) In the event that liquid n-propyl nitrate is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation and then clean up the spill.

(2) Liquid n-propyl nitrate shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of vapors are permitted.

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

(2) Employers shall ensure that employees who handle liquid n-propyl nitrate 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 n-propyl nitrate 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 n-propyl nitrate above the action level without regard to the use of respirators, or employees who may have repeated or prolonged skin contact, or who may have eye contact with liquid n-propyl nitrate, or employees who work where n-propyl nitrate presents a fire or explosion hazard, shall annually:

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

(ii) Advise affected employees as to the signs and symptoms of exposure to n-propyl nitrate.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of overexposure to n-propyl nitrate 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 n-propyl nitrate.

(j) Medical surveillance. (1) The employer shall provide 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 examinations. The employer shall make available to each employee who is exposed, or will be exposed, to liquid n-propyl nitrate or airborne concentrations of n-propyl nitrate at or above the action level, without regard to the use of respirators, a preplacement medical examination which must include the following:

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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(ii) A complete blood count to include at least red and white cell count, a differential smear, hemoglobin and hematocrit.

(3) Periodic medical examination. The employer shall make available to each employee exposed to liquid n-propyl nitrate or airborne concentrations of n-propyl nitrate at or above the action level, without regard to the use of respirators, twelve months from the date of the employee's first exposure, and every twelve months thereafter, a periodic medical examination which must include the following:

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

(ii) A complete blood count to include at least red and white cell count, a differential smear, hemoglobin and hematocrit.

(4) Alternative medical procedures. If the examining physician chooses to use alternative medical 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:

(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 methemoglobin determination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to n-propyl nitrate which are listed in Appendix A or if overexposure to n-propyl nitrate 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 n-propyl nitrate;

(ii) A description of the affected employee's duties as they relate to his exposure to n-propyl nitrate;

(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 n-propyl nitrate;

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(B) Any recommended limitations upon the employee's exposure to n-propyl nitrate, 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 blood tests;

(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 n-propyl nitrate in such a way as would put the employee at increased risk of material impairment of his health from such 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 n-propyl nitrate.

(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 n-propyl nitrate.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to n-propyl nitrate 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

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;
- (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 n-propyl nitrate;

(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 n-propyl nitrate.

(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 n-propyl nitrate which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to n-propyl nitrate 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

(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 n-propyl nitrate that are being performed at the place of exposure; and
- (iii) Record the results obtained.

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

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR N-PROPYL NITRATE

- I. SUBSTANCE IDENTIFICATION
 - A. Substance: n-Propyl nitrate
 - B. Permissible Exposure: 25 parts of n-propyl nitrate per million parts of air (ppm) (110 milligrams of n-propyl nitrate per cubic meter of air (mg/M3)) averaged over an eight-hour work shift.
 - C. Appearance and Odor: Colorless to pale yellow liquid with an ether-like odor
- II. HEALTH HAZARD DATA
 - A. Ways in which the chemical affects your body: n-Propyl nitrate can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it.
 - B. Effects of Overexposure:
 - 1. Short-term Exposure: Animal studies show that n-propyl nitrate causes temporary low blood pressure and may affect the ability of the blood to carry oxygen by forming methemoglobin. In man, methemoglobin formation may cause bluish discoloration of the skin, headache, weakness, drowsiness, nausea, rapid heart beat, shortness of breath, and unconsciousness.
 - 2. Long-term Exposure: In animals repeated or prolonged exposure to n-propyl nitrate has caused irritation and thickening of the skin. It may also cause anemia.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

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 n-propyl nitrate.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If liquid n-propyl nitrate gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If liquid n-propyl nitrate gets on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid n-propyl nitrate gets on your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation is present after washing, get medical attention promptly.
- C. Breathing: If you or any other person breathes in large amounts of n-propyl nitrate 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.
- D. Swallowing: When liquid n-propyl nitrate 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.
- 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 emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to n-propyl nitrate. 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 n-propyl nitrate while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

- B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with liquid n-propyl nitrate. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles where liquid n-propyl nitrate may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. n-Propyl nitrate is a flammable liquid and its vapors can easily form explosive mixtures with air.
- B. n-Propyl nitrate must be stored in tightly closed containers in a cool, well ventilated area away from heat, strong oxidizers and combustible materials.
- C. Sources of ignition such as smoking and open flames are prohibited wherever n-propyl nitrate is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- D. You must use non-sparking tools when opening or closing containers of n-propyl nitrate, and metal containers must be bonded and grounded when pouring or transferring liquid n-propyl nitrate.
- E. You must promptly remove any non-impervious clothing that becomes contaminated with n-propyl nitrate and this clothing must not be reworn until the n-propyl nitrate is removed from the clothing.
- F. Clothing wet with n-propyl nitrate can easily be ignited. You must immediately remove this clothing and it must not be reworn until the n-propyl nitrate has evaporated from the clothing.
- G. If your skin becomes contaminated with n-propyl nitrate, you must promptly wash or shower with soap or mild detergent and water to remove the n-propyl nitrate from your skin.
- H. If you handle liquid n-propyl nitrate, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- I. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.
- J. Ask your supervisor where n-propyl nitrate 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 n-propyl nitrate. In addition, your employer must instruct you in the safe use of n-propyl nitrate, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to n-propyl nitrate. 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

- 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 n-propyl nitrate is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent that the information supplements this regulation for n-propyl nitrate, it is advisory in nature.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR N-PROPYL NITRATE

- I. PHYSICAL AND CHEMICAL DATA
 - A. Substance Identification
 - 1. Synonyms: None
 - 2. Formula: C3H8NO3
 - 3. Molecular weight: 105.1
 - B. Physical Data
 - 1. Boiling point (760 mm Hg): 111 C (231 F)
 - 2. Specific gravity (water = 1): 1.06
 - 3. Vapor density (air = 1 at boiling point of n-propyl nitrate): 3.6
 - 4. Melting point: Less than -101 C (-150 F)
 - 5. Vapor pressure at 20 C (68 F): 18 mm Hg
 - 6. Solubility in water, % by weight at 20 C (68 F): Insoluble
 - 7. Evaporation rate (butyl acetate = 1): Data not available
 - 8. Appearance and odor: Colorless to pale yellow liquid with an ether-like odor
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
 - A. Fire
 - 1. Flash point: 20 C (68 F) (closed cup)
 - 2. Autoignition temperature: 175 C (347 F)
 - 3. Flammable limits in air, % by volume: Lower: 2; Upper: 100
 - 4. Extinguishing media: Foam, dry chemical

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

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. Fires involving n-propyl nitrate should be fought from an explosion resistant location because of the possibility of detonation.
6. Unusual fire and explosion hazards: n-Propyl nitrate is a flammable liquid. Its vapors can easily form explosive mixtures with air over a wide range of concentrations. All ignition sources must be controlled where n-propyl nitrate is used, handled or stored in a manner that could create a potential fire or explosion hazard. n-Propyl nitrate vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which n-propyl nitrate is handled. Its ignition energy is very low comparable to hydrogen, acetylene and carbon disulfide.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, n-propyl nitrate is classified as a Class IB flammable liquid. For example, 5000 ppm, approximately one-fourth of the lower flammable limit, is one situation in which n-propyl nitrate is considered to be a potential fire and explosion hazard.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for n-propyl nitrate shall be Class I Group B.

B. Reactivity

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact with either strong oxidizers or with combustibles may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving n-propyl nitrate.
4. Special precautions: n-Propyl nitrate will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If n-propyl nitrate is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources.
 2. Ventilate area of spill or leak.
 3. For small quantities, stir with a solution of sodium hydroxide or soda ash in water until oily layer disappears, then flush. Large quantities can be burned under the supervision of personnel qualified to dispose of explosives. Liquid n-propyl nitrate may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of n-propyl nitrate vapors are permitted.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: n-Propyl nitrate may be disposed of as described above.

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 instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analysis. The method of measurement must determine the concentration of n-propyl nitrate 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 n-propyl nitrate 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 2" (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 n-propyl nitrate in tightly closed containers in a cool, well ventilated area.
- B. High exposures to n-propyl nitrate can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close n-propyl nitrate containers. Metal containers must be effectively grounded and bonded prior to pouring.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

D. Employers should advise employees of all areas and operations where their exposure to n-propyl nitrate could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to n-propyl nitrate is likely to occur are: During its production and its use as a liquid rocket propellant.

NOTE: The information contained in the following appendix is neither intended, by itself, to create any additional obligations nor otherwise impose or detract from any existing obligations and to the extent the information supplements this regulation for n-propyl nitrate, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

n-Propyl nitrate vapor causes anoxia due to the formation of methemoglobin. Exposure of rats to 10,000 ppm for 4 hours caused nasal irritation, dyspnea, methemoglobinemia, weakness, cyanosis, and death. In dogs repeatedly exposed to 260 ppm for 26 weeks, hemoglobinuria and mild anemia appeared during the first 2 weeks of exposure but then subsided. n-Propyl nitrate may induce hypotension in animals by direct action on vascular muscles. The liquid when placed into the eyes of rabbits caused mild transient inflammation with no evidence of corneal damage. The liquid applied to the skin of rabbits daily for 10 days caused staining, inflammation, and thickening of the skin but no evidence of systemic toxicity. n-Propyl nitrate has the potential to form methemoglobin in man; the effects of methemoglobinemia result from anoxia and include cyanosis especially evident in the lips, nose, and ear lobes; other effects are weakness, dizziness, and severe headache.

III. SIGNS AND SYMPTOMS

By analogy to effects caused in animals, it may cause the formation of methemoglobin which results in signs of anoxia including cyanosis of lips, nose, and ear lobes; at high exposure, it may cause methemoglobinemia, mild anemia, dyspnea, weakness, dizziness and headache, and irritation of the eyes and skin.

IV. SPECIAL TESTS

Determination of methemoglobin concentration in the blood when n-propyl nitrate intoxication is suspected, and at regular intervals until the methemoglobin has been fully reduced to normal hemoglobin.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

V. TREATMENT

Remove from exposure. Give artificial resuscitation and administer oxygen if indicated. Any n-propyl nitrate on the body must be removed as a precautionary measure. Determine methemoglobin in blood and repeat every 3 to 6 hours for 18 to 24 hours. Consideration may be given to the intravenous administration of methylene blue at high levels of methemoglobin in an attempt to accelerate the conversion of methemoglobin to hemoglobin; however, the use of this agent is controversial due to its toxic effects.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

n-Propyl nitrate causes the formation of methemoglobin in animals; this might occur in humans if overexposed, together with a reversible hypotension. It is important that the physician become familiar with plant operating conditions in which exposure to n-propyl nitrate 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 n-propyl nitrate:

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. Examination of the blood, cardiovascular system, skin, nervous system, and kidneys should be stressed.
2. A complete blood count -- n-Propyl nitrate has been shown to cause methemoglobinemia in animals. Persons with blood disorders may be at increased risk from exposure. A complete blood count must be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis. Methemoglobin determinations shall be performed if overexposure is suspected or signs and symptoms of toxicity occur.

VII. REFERENCES

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

1. American Conference of Governmental Industrial Hygienists: "n-Propyl Nitrate," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 217-218.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2090-2092.
3. Rinehart, W.E., et al: "Studies on the Toxicity of n-Propyl Nitrate Vapor," American Industrial Hygiene Association Journal, 19:80-83, 1958.
4. Murtha, E.F., et al: "Some Pharmacological Effects of N-Propyl Nitrate, Journal of Pharmacology and Experimental Therapeutics, 118:77-83, 1956.
5. Hood, D.B.: Haskell Laboratory for Toxicology and Industrial Medicine Report No. 21-53, Toxicity of n-Propyl Nitrate and Isopropyl Nitrate, E.I. du Pont de Nemours and Company, Wilmington, Delaware, 1953.
6. Boysen, J.E.: "Health Hazards of Selected Rocket Propellants," Archives of Environmental Health, 7:77-81, 1963.
7. Mangelsdorff, A.F.: "Treatment of Methemoglobinemia," A.M.A. Archives of Industrial Health, 14:148-153, 1956.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

REFERENCES AND SOURCES

N-PROPYL NITRATE

1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Patty, "Industrial Hygiene and Toxicology"
Skin: American Conference of Governmental Industrial Hygienists,
"Documentation of the Threshold Limit Values in Workroom
Air;" Patty, Industrial Hygiene and Toxicology"
Ingestion: Patty, "Industrial Hygiene and Toxicology;" International
Labour Office, "Encyclopedia of Occupational Health and Safety;"
Hamilton and Hardy, "Industrial Toxicology"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

Patty reports, "undiluted n-propyl nitrate instilled into rabbits' eyes results in mild transient inflammation without evidence of corneal damage."

A classification of 2 is, therefore, concluded to be appropriate.

Skin - Classification: 2

Output statement numbers: 2, 7b, 17g and 21 combined, 17i
and 20a

Exceptions: None

According to the ACGIH, the percutaneous toxicity of this compound is low, "but inflammation and thickening of the skin may follow repeated application. Some signs and symptoms resulting from repeated absorption become less severe or disappear on continued exposure."

Patty agrees and adds that doses of 11 and 17 g/kg applied to rabbit skin had effects which were "essentially none."

The boiling point of this compound is 231 degrees F.

Its vapor pressure is 18 mm Hg at 20 degrees C and it is insoluble in water. Its flash point is 68 degrees F.

A classification of 2 is concluded to be most appropriate and adequate.

Ingestion - Classification: 2

Output statement numbers: 20a

Exceptions: None

Patty states that "pharmacological and acute toxicity studies in animals have shown that n-propyl nitrate produces hypotension, presumably by its direct action on vascular muscles, and methemoglobinemia. It has relatively low acute oral and intravenous toxicity for rats, cats and dogs. Pathological examinations have revealed either no changes or moderate non-specific tissue changes compatible (sic) with anoxia. These consist of congestion of the brain, liver, and myocardium and occasionally increased pigment deposition in liver and spleen." In general, Patty further notes, "the chief effects of the aliphatic nitrates are dilatation of blood vessels and methemoglobin formation. The vascular dilation accounts for the characteristic lowering of blood pressure and headache. The individual

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

members in the series differ in intensity and duration of these effects. Animals given effective doses by mouth or parenterally exhibit such signs and symptoms as marked depression in blood pressure, tremors, ataxia, lethargy, alteration in respiration (usually hyperpnea) cyanosis, prostration and convulsion. Death, when it occurs, is either from respiratory or cardiac arrest. Animals surviving acute exposures recover promptly."

The ILO continues with the general effects of alkyl nitrates saying that they are "highly toxic and in large doses may cause dizziness, abdominal cramps, vomiting, bloody diarrhoea, weakness, convulsions and collapse. Small, repeated doses may lead to weakness, general depression, headache, and mental disorders."

Hamilton and Hardy note that "most nitrates produce Heinz bodies . . . commonly associated with methemoglobin." Patty, however, states that "toxicity data are not sufficiently complete to permit further comparisons of the effectiveness of the nitrates in producing Heinz body formation. In the case of the aliphatic nitrates, erythrocytes containing Heinz bodies disappear from the circulating blood more slowly than methemoglobin."

Patty notes the lethal oral dose for the rat as 7.9 g/kg and 5.0 g/kg respectively, and 1.0 g/kg and 1.5 g/kg as causing weakness, incoordination and cyanosis.

The low acute toxicity of the substance and the fact that animals surviving acute exposures recover promptly indicates that a classification of 2 is sufficient to prevent acute effects and any chronic effects which may occur.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

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

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

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 8, p. 688 (K-O)

P. Gray and M. W. T. Pratt, Journal Chem. Soc., 2165, 1967 (G and P)

Sources of data items used:

- I. A. 1. Synonyms: None
- 2. Formula: NFPA-49
- 3. Molecular weight: Lange
- B. 1. Boiling point: NFPA-325M, Lange, K-O
- 2. Specific gravity: NFPA-49, Lange
- 3. Vapor density: ADL
- 4. Melting point: K-O
- 5. Vapor pressure: G and P
- 6. Solubility in water: NFPA-325M, NFPA-49
- 7. Evaporation rate: Data not available
- 8. Appearance and odor: NFPA-49
- II. A. 1. Flash point: NFPA-49, NFPA-325M
- 2. Autoignition temperature: NFPA-325M
- 3. Flammable limits: NFPA-325M
- 4. Extinguishing media: NFPA-325M, NFPA-49

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

- 5. Special fire fighting procedures: NFPA-49
- 6. Unusual fire and explosion hazards: NFPA-49, NFPA-325M
- B. 1. Conditions contributing to instability: ADL
- 2. Incompatibilities: NFPA-49
- 3. Hazardous decomposition products: NFPA-49
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: NFPA-49, ADL
- C. Waste disposal method: ADL
- V. Miscellaneous precautions: NFPA-49, ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Boysen, J. E., "Health Hazards of Selected Rocket Propellants," Arch. Environ. Health, 7, p. 71 - 81, 1963 (NIOSH Technical Information Service NIOSH 15692)

International Labour Office, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience, 2nd edition, 1972 (K-O)

Kit, B. and Evered, D. S., "Rocket Propellant Handbook," MacMillan, 1960 (Kit)

Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)

References for Specific Use/Exposure

1. Kit, Patty, NIOSH 15692, K-O, ILO

2. ILO, Patty, Kit

References for Specific Control Methods

Kit, Patty and ILO were the references used for both of the Specific Control Methods.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: n-Propyl nitrate

D. O. L. STANDARD: 25 ppm

WARNING PROPERTIES:

Odor Threshold: According to the Documentation of TLV's, "the odor (of n-propyl nitrate) is stated to be detectable at 50 ppm and above."

Eye Irritation Level: n-Propyl nitrate is not known to be an eye irritant.

Evaluation of Warning Properties: Since the odor threshold of n-propyl nitrate is only 2 times greater than the permissible exposure limit, n-propyl nitrate is treated as a material with good warning properties.

Since this substance is a powerful oxidizing agent, and the Acme Protection Guide points out that n-propyl nitrate is "potentially explosive with activated carbon" only non-combustible sorbents are allowed for use cartridges and canisters.

IDLH: 2000 ppm

Basis for IDLH Value: The chosen IDLH is based upon the report in the Documentation of TLV's that the 4-hour LC50 for the dog is 2000 - 2500 ppm n-propyl nitrate.

Other Toxicological Information: According to the Documentation of TLV's, "the inhalation of propyl nitrate vapor for four hours at a concentration of 10,000 ppm produced cyanosis, methemoglobinemia and death in rats. Murtha, et al. found the intravenous LD50 in unanesthetized rabbits to be 200 - 250 mg/kg. In anesthetized dogs and cats intravenous doses of 100 - 200 mg/kg were usually fatal. From a series of pharmacologic studies, these authors concluded that propyl nitrate exerts a direct action on vascular smooth muscle and that cardiac effects and respiratory depression probably contributed to the hypotensive action of the compound.

"Rinehart, et al. carried out an extensive series of single and repeated inhalation trials in mice, rats, hamsters, guinea pigs and dogs. The LC50's for a single four-hour exposure were calculated to be 9000 - 10,000 ppm for rats, 6000 - 7000 ppm for mice and 2000 - 2500 ppm for dogs. . . (The TLV of 25 ppm) would seem to represent a concentration with a considerable factor of safety from systemic effects, notably methemoglobinemia and cyanosis, and hypotension. Experience data on exposed workers are needed to confirm the value."

The following information can be found in a table in Patty:

RESPONSE TO INHALATION OF VARIOUS CONCENTRATIONS OF
N-PROPYL NITRATE -- ANIMALS

Animal	Concentration, ppm	Duration of exposure	Mortality
Rats	7134	4 hours	1/10
	5816	4 hours	1/10
Mice	7134	4 hours	15/20
	5816	4 hours	2/10
Dog	2000	11 hours	3/3

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

LFL: 20,000 ppm

VAPOR PRESSURE AT 20 C: 18 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 23,700 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-PROPYL NITRATE

USE/EXPOSURE AND CONTROL DOCUMENT
N-PROPYL NITRATE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during use in liquid rocket propellants	A,B	Local exhaust ventilation; personal protective equip- ment (respiratory protective devices, skin protection); good personal hygiene practice
2.	Inhalation of vapor and skin contact with liquid during limited manufac- ture and distribution and during maintenance of equipment and storage containers	A,B	Local exhaust ventilation; personal protective equip- ment (respiratory protective devices, skin protection); good personal hygiene practice

- 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 -----

1,277 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

