

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** DINITROTOLUENE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DINITROTOLUENE

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 DINITROTOLUENE.

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 dinitrotoluene not in excess of 1.5 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 dinitrotoluene.

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

(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 dinitrotoluene;

(ii) Any measurements of dinitrotoluene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to dinitrotoluene; 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 dinitrotoluene 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 dinitrotoluene 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 dinitrotoluene 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 dinitrotoluene 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 dinitrotoluene 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 dinitrotoluene 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	± 25%
At or below permissible exposure and above the action level	± 35%
At or below the action level	± 50%

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

(2) Employee exposures to airborne concentrations of dinitrotoluene 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 dinitrotoluene.

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

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

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

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(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of dinitrotoluene 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 DINITROTOLUENE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Particulate or Vapor Concentration	
15 mg/M3 or less	Any supplied-air respirator.
	Any self-contained breathing apparatus.
75 mg/M3 or less	Any supplied-air respirator with a full facepiece, helmet or hood.
	Any self-contained breathing apparatus with a full facepiece.
200 mg/M3 or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet or hood operated in continuous-flow mode.
Greater than 200 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.
	Any escape self-contained breathing apparatus.

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(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 dinitrotoluene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of dinitrotoluene shall be Class II, Group G; for molten dinitrotoluene shall be Class I, Group C.

(3) For the purpose of compliance with § 1910.157, dinitrotoluene 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 dinitrotoluene shall be Class II, Group G; for molten dinitrotoluene shall be Class I, Group C.

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

(6) Dinitrotoluene shall be stored so as not to come in contact with strong oxidizers, caustics, and chemically active metals such as tin and zinc.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields, (eight-inch minimum) and other appropriate protective clothing necessary to prevent any possibility of skin contact with molten dinitrotoluene. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent skin contact with dinitrotoluene or liquids containing dinitrotoluene where skin contact may occur. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(3) Employers shall ensure that employees whose clothing may have become contaminated with solid dinitrotoluene change into uncontaminated clothing before leaving the work premises.

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

(5) Where exposure of an employee's body to molten dinitrotoluene or liquids containing dinitrotoluene may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(6) Employers shall ensure that non-impervious clothing which becomes wet with molten dinitrotoluene or liquids containing dinitrotoluene be removed immediately and that non-impervious clothing which becomes contaminated with solid dinitrotoluene be removed promptly and such clothing shall not be re worn until the dinitrotoluene is removed from the clothing.

(7) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply

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with § 1910.133(a)(2)-(a)(6) where there is any possibility of eye contact with molten dinitrotoluene.

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

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

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

(3) Employers shall ensure that employees whose skin becomes contaminated with dinitrotoluene promptly wash or shower with soap or mild detergent and water to remove any dinitrotoluene from the skin.

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

(5) Employers shall ensure that employees who handle dinitrotoluene or liquids containing dinitrotoluene 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 dinitrotoluene 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 dinitrotoluene above the action level or employees who may have skin or eye contact with dinitrotoluene or liquids containing dinitrotoluene, or employees who work where dinitrotoluene presents a potential fire or explosion hazard, shall annually:

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

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

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to dinitrotoluene 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 dinitrotoluene.

(j) Medical surveillance. (i) 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 dinitrotoluene or liquids containing dinitrotoluene or airborne concentrations of dinitrotoluene at or above the action level a preplacement medical examination which must include the following:

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(i) A medical history and physical examination with emphasis on the blood, liver, and heart;

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

(iii) A profile of liver function.

(3) Periodic medical examination. The employer shall make available to each employee exposed to dinitrotoluene or liquids containing dinitrotoluene or airborne concentrations of dinitrotoluene 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, liver, and heart;

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

(iii) A profile of liver function.

(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:

(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 dinitrotoluene which are listed in Appendix A which the employee suspects are caused by exposure to dinitrotoluene.

(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 dinitrotoluene;

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

(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.

specifically stating:

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(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 dinitrotoluene or would directly or indirectly aggravate any detected medical condition;

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

(8) Physician's written opinion. i) the physician's written opinion shall be a signed statement by the examining physician

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

(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:

(i) A recording of the results of the blood tests and liver function 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 dinitrotoluene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(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 dinitrotoluene.

(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 dinitrotoluene.

(ii) This record shall include:

(A) The date of measurement;

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

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- (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;
 - (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 dinitrotoluene;
 - (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 dinitrotoluene.
 - (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.

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(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 dinitrotoluene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to dinitrotoluene 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 dinitrotoluene that are being performed at the place of exposure; and
- (iii) Record the results obtained.

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

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR DINITROTOLUENE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Dinitrotoluene
- B. Permissible Exposure: 1.5 milligrams of dinitrotoluene per cubic meter of air (mg/M3) averaged over an eight-hour work shift.
- C. Appearance and Odor: Orange-yellow solid (sometimes shipped molten in tank cars) with a characteristic odor

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Dinitrotoluene 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 is readily absorbed through your skin. Even a small amount absorbed from the clothes or shoes may cause toxic symptoms.
- B. Effects of Overexposure:
 1. Short-term Exposure: Dinitrotoluene affects the ability of blood to carry oxygen normally. A bluish discoloration of the skin may occur with headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness and unconsciousness. If

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treatment is not given promptly, death may occur. The onset of symptoms may be delayed. The ingestion of alcohol may cause increased susceptibility to the effects of dinitrotoluene.

2. Long-term Exposure: Repeated or prolonged exposure to dinitrotoluene may cause anemia and jaundice.
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 dinitrotoluene.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If dinitrotoluene or liquids containing dinitrotoluene get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. If molten dinitrotoluene gets into your eyes, flush your eyes immediately with large amounts of water to remove heat. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If dinitrotoluene or liquids containing dinitrotoluene get on your skin, immediately wash the contaminated skin using soap or mild detergent and water. If dinitrotoluene or liquids containing dinitrotoluene penetrate through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately. If molten dinitrotoluene gets on your skin, immediately flush the skin with water to remove heat. Wash the skin with soap or mild detergent and water. Get medical attention immediately.
- C. Breathing: If you or any other person breathes in large amounts of dinitrotoluene 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 dinitrotoluene has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.
- 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 equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to dinitrotoluene. 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

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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 can smell dinitrotoluene 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.

- B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent any possibility of skin contact with molten dinitrotoluene. You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with dinitrotoluene or liquids containing dinitrotoluene. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of skin contact with molten dinitrotoluene.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Dinitrotoluene may be detonated under strong confinement by shock from high explosives and may detonate if involved in a fire.
- B. Dinitrotoluene must be stored in tightly closed containers in a cool, well ventilated area away from heat, strong oxidizers, caustics, and chemically active metals such as tin and zinc.
- C. Sources of ignition such as smoking and open flames are prohibited wherever dinitrotoluene is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- D. If your work clothing may have become contaminated with solid dinitrotoluene, you must change into uncontaminated clothing before leaving the work premises.
- E. You must immediately remove any non-impervious clothing that becomes wet with molten dinitrotoluene or liquids containing dinitrotoluene and you must promptly remove any non-impervious clothing that becomes contaminated with dinitrotoluene. This clothing must not be reworn until the dinitrotoluene is removed from the clothing.
- F. If your skin becomes wet with molten dinitrotoluene or liquids containing dinitrotoluene, you must immediately wash or shower with soap or mild detergent and water to remove the dinitrotoluene from your skin.
- G. If your skin becomes contaminated with dinitrotoluene, you must promptly wash or shower with soap or mild detergent and water to remove the dinitrotoluene from your skin.

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- H. If you are subject to skin contact with dinitrotoluene, molten dinitrotoluene or liquids containing dinitrotoluene at the end of each work day you must wash with soap or mild detergent and water any areas of your body that may have contacted dinitrotoluene.
- I. You must not eat or smoke in areas where dinitrotoluene or liquids containing dinitrotoluene are handled, processed or stored.
- J. If you handle dinitrotoluene or liquids containing dinitrotoluene, you must wash your hand thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- K. Fire extinguishers and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.
- L. Ask your supervisor where dinitrotoluene 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 dinitrotoluene. In addition, your employer must instruct you in the safe use of dinitrotoluene, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to dinitrotoluene. 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.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
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I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2,4-dinitrotoluene; DNT
2. Formula: 2,4-(NO₂)₂C₆H₃CH₃
3. Molecular weight: 182.1

B. Physical data

1. Boiling point (760 mm Hg): Slow decomposition at 250 C (482 F); self-sustained decomposition at 270 C (518 F)
2. Specific gravity (water = 1): Solid: 1.52; Liquid: 1.32
3. Vapor density (air = 1 at boiling point of dinitrotoluene): Not applicable (too high boiling)
4. Melting point: 70 C (158 F)
5. Vapor pressure at 20 C (68 F): 1 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.03
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Orange-yellow solid (sometimes shipped molten in tank cars) with a characteristic odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 206.7 C (404 F) (closed cup)
2. Autoignition temperature: Data not available
3. Impact sensitivity (minimum fall of a 2 kg weight to cause at least one explosion in ten trials): Greater than 100 centimeters
4. Flammable limits in air, % by volume: Not available
5. Extinguishing media: Water, dry chemical, carbon dioxide
6. 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 dinitrotoluene should be fought from an explosion-resistant location because of the possibility of detonation of dinitrotoluene. In advanced or massive fires, the area should be evacuated.
7. Unusual fire and explosion hazards: Dinitrotoluene may be detonated only by a strong initiator. All ignition sources must be controlled where dinitrotoluene is used, handled or stored in a manner that could create a potential fire or explosion hazard. It undergoes a self-sustaining decomposition and may burst containers when heated above 270 C (518 F). Fires involving dinitrotoluene form dense black smoke.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electric Code for dinitrotoluene shall be Class II, Group G; for molten dinitrotoluene shall be Class I, Group C.

B. Reactivity

1. Conditions contributing to instability: Temperatures above 250 C (482 F).
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosion. Contact with caustics and

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chemically active metals such as tin or zinc may cause evolution of heat and increase in pressure.

3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving dinitrotoluene.
4. Special precautions: Liquid dinitrotoluene will attack some forms of plastics, rubber and coatings.

III. SPILL AND DISPOSAL PROCEDURES

- A. If dinitrotoluene is spilled, the following steps should be taken:
 1. Remove all ignition sources.
 2. Ventilate area of spill.
 3. For small quantities, sweep onto paper or other suitable material and burn in a suitable combustion chamber which allows burning in an unconfined condition and is equipped with an appropriate effluent gas cleaning device. Large quantities may be reclaimed; however, if this is not practical, dissolve in fuel oil and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
 4. If in the molten form, allow to cool and solidify and treat as in (3) above.

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

- C. Waste disposal methods: Dinitrobenzene may be disposed of:
 1. By making packages of dinitrotoluene in paper or other flammable material and burning in a suitable combustion chamber which allows burning in an unconfined condition and is equipped with an appropriate effluent gas cleaning device.
 2. By dissolving dinitrotoluene in fuel oil and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of dinitrotoluene to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories

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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 dinitrotoluene to plus or minus 25%.

C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set P" (Order number XXXXXXXXXXX).

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 dinitrotoluene in tightly closed containers in a cool, well ventilated area.

B. When melting dinitrotoluene, you should not heat it above 100 C (212 F) because of danger of rapid decomposition.

C. Employers should advise employees of all areas and operations where exposure to dinitrotoluene could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to dinitrotoluene is likely to occur are: During its production; during its use as an intermediate in the manufacture of explosives, dyes and isocyanates for urethane polymers; and during its use in organic synthesis.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Dinitrotoluene absorption, whether from inhalation of the vapor or absorption of the solid through skin, causes anoxia due to the formation of methemoglobin; jaundice and anemia have been reported. Signs and symptoms of overexposure are due to the loss of oxygen-carrying capacity of the blood. Rapid absorption through the intact skin is frequently the main route of entry. The onset of symptoms of methemoglobinemia is often insidious, and may be delayed for up to 4 hours; headache is commonly the first symptom and may become quite intense as the severity of methemoglobinemia progresses. Cyanosis develops early in the course of intoxication, first in the lips, the nose, and the ear lobes, and is often recognized by fellow workers. Cyanosis occurs when the methemoglobin concentration is 15 percent or more. The individual may feel well, have no complaints, and may insist that nothing is wrong until

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the methemoglobin concentrations approaches approximately 40 percent. At methemoglobin concentrations of over 40 percent there usually is weakness and dizziness; up to 70 percent concentration there may be ataxia, dyspnea on mild exertion, tachycardia, nausea, vomiting, and drowsiness. Ingestion of alcohol is reported to aggravate the toxic effects of dinitrotoluene.

III. SIGNS AND SYMPTOMS

Signs of anoxia with cyanosis; anemia, jaundice.

IV. SPECIAL TESTS

Determination of methemoglobin concentration in the blood when dinitrotoluene intoxication is suspected, and at regular intervals until the methemoglobin has been fully reduced to normal hemoglobin. Determination of dinitrotoluene in the urine; urinary excretion of dinitrotoluene in excess of 25 mg/liter of urine indicates significant absorption.

V. TREATMENT

Remove from exposure. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation if indicated. Any dinitrotoluene on the body must be removed. Immediately remove all contaminated clothing, including shoes, and wash entire body with plenty of soap or mild detergent and water. Scrub hands. Shampoo hair and scalp. Clean finger and toe nails. Clean nostrils and ear canals. Give oxygen and confine to bed. In case of eye splashes, flush with water. Determine methemoglobin in blood and repeat every 3 to 6 hours for 18 to 24 hours. Repeat showers and skin cleansing if methemoglobin appears to rise after 3 to 4 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

Most reported effects of dinitrotoluene are caused by its capacity to produce anoxia due to formation of methemoglobin. It readily penetrates shoes, clothing, and leather gloves, so that a small area of contamination on clothing or gloves will produce evidence of poisoning if left in contact with the skin for several hours since skin absorption may be the major route of entry. It is important that the physician become familiar with plant operating conditions in which exposure to dinitrotoluene 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.

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B. PREPLACEMENT

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

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, liver, and cardiovascular system should be stressed.
2. A complete blood count -- Dinitrotoluene has been shown to cause methemoglobinemia. Those with blood disorders may be at increased risk. 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. Observe for Heinz bodies.
3. Liver function tests -- Since liver damage has been observed in humans exposed to dinitrotoluene, a profile of liver function shall be obtained by using a medically acceptable array of biochemical tests.

C. PERIODIC EXAMINATIONS

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

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Dinitrotoluene," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 93-94.
2. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet SD-93, Dinitrotoluenes, Washington, D.C., 1966, pp. 5-6, 14-15.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2105-2121, 2130-2131.
4. von Oettingen, W.F.: The Aromatic Amino and Nitro Compounds, Their Toxicity and Potential Dangers, U.S. Public Health Service Bulletin No. 271, U.S. Government Printing Office, Washington, D.C., 1941, pp. 108-111.
5. Lynch, A.L.: "Biological Monitoring for Industrial Exposure to Cyanogenic Aromatic Nitro and Amino Compounds," American Industrial Hygiene Association Journal, 35:426-432, 1974.

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6. Mangelsdorff, A.F.: "Treatment of Methemoglobinemia," A.M.A.
Archives of Industrial Health, 14:148-153, 1956.

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REFERENCES AND SOURCES
DINITROTOLUENE
1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: Grant, "Toxicology of the Eye;" Manufacturing Chemists' Association, "Chemical Safety Data Sheets"
- Skin: American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" Sax, "Dangerous Properties of Industrial Materials;" Patty, "Industrial Hygiene and Toxicology;" Manufacturing Chemists' Association, "Chemical Safety Data Sheets;" International Labour Office, "Encyclopedia of Occupational Health and Safety"
- Ingestion: Grant, "Toxicology of the Eye;" Manufacturing Chemists' Association, "Chemical Safety Data Sheets;" Gleason, "Toxicology of Commercial Products;" Spector, "Handbook of Toxicology;" American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" International Labour Office, "Encyclopedia of Occupational Health and Safety"

COMMENTS

Eye - Classification: 0 and 1

Output statement numbers: 9

Exceptions: None

According to Grant, a case of severe burn of the "cornea of one eye with permanent scarring," has been attributed to "hot fumes of dinitrotolulene."

The NCA states, "since dinitrotoluene is a solid at room temperature, splashes in the eyes will not occur unless the chemical is hot and then associated thermal burns can be expected. Eyes splashed with molten dinitrotoluene or liquids containing dinitrotoluene dust should be flushed with copious amounts of water."

There is no specific indication in the literature that solid dinitrotoluene or liquids containing it can cause harm to the eye. Indeed, for dinitrobenzene, Grant reports "there was no inflammatory response when this substance was brought into contact with the uveal tract, retina, or conjunctiva." Since this is a related compound, there would not appear to be justification for requiring eye protection other than where there is a possibility of eye contact with molten dinitrotoluene or its hot fumes. The substance therefore, is given a classification of 1 only for its molten form. A requirement for eye wash fountains is not considered justifiable, although their availability is certainly advisable.

Skin - Classification: 1, 2, and 6

Output statement numbers: 1, 2, 5b, 7a, 8b, 14g and 17g combined
14i, 15, 17i, 20a

Exceptions: See below

The ACGIH reports that dinitrotoluene exposure can lead to early symptoms of "headache, fatigue, nausea, vomiting, marked chest pain and loss of weight. More advanced symptoms

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are jaundice and secondary anemia."

According to Patty, most nitro-amino compounds affect humans by their "strong methemoglobin production, resulting when the substance, as does DNT, is readily absorbed through intact skin."

The MCA states "because DNT absorption through the intact skin is rapid, direct skin contact must be avoided." It recommends that contaminated clothing be removed and that affected areas be "immediately" washed and notes "a shower and a change of clothing at the end of the work shift should be mandatory."

On a scale of 1 (slight) to 6 (severe), ILO gives the cyanosis hazard of DNT as a 5, the anemia hazard as a 6, and the overall toxic hazard as a 5.

Sax considers the acute and chronic effects by skin absorption to be of high toxic hazard. Additionally, he lists it as an acute and chronic local allergen of moderate toxic hazard and as an acute local irritant of slight toxic hazard. He notes the compound can cause "anemia, methemoglobinemia, cyanosis and liver damage." In general, he states "poisoning with the solid nitro compounds is usually slower and less severe than is the case with the liquid nitro and amino benzenes since absorption is less rapid. Thus, chronic poisoning occurs more frequently than acute, the picture in the chronic form being one of anemia moderate cyanosis, fatigue, slight dizziness, headache, insomnia and loss of weight. Prolonged chronic exposure may result in damage to the liver and kidneys, with production of acute yellow atrophy, toxic hepatitis and fatty degeneration of the kidneys."

DNT has a melting point of 158 degrees F and a flash point of 404 degrees F. At 20 degrees C, its vapor pressure is 1 mm Hg. It is 0.03% soluble in water.

The above data clearly indicate that skin absorption is a significant route of entry and that the acute and chronic systemic effects of such exposures can be severe. To prevent these effects, it is concluded that overall classifications of 1, 2 and 6 are most appropriate with the classification of 1 being for the molten form. However, because of the hazards and properties of the substance, the following exceptions are made. Statement 2 is modified to prevent skin contact where it may occur. Statement 8b is used for the molten form and for liquids containing the substance, since the presence of a vehicle may increase the rapidity of skin absorption. This follows from the comments of Sax. Similarly, statements 14g and 14i are used where clothing or skin becomes wet with such a liquid. Finally, statement 15 is specified based on recommendations in the literature concerning these substances in general (see Patty).

Ingestion - Classification: 1 and 5

Output statement numbers: 19, 20a

Exceptions: None

Grant states that DNT is "an explosive yellow substance which

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has been known to cause systemic intoxication."

The "systemic intoxication," however, is limited to methemoglobinemia and has shown "relatively few" other toxicological effects, according to the MCA. The MCA also states that "there are no chronic effects from single exposures."

The Documentation of TLV's reports that "dinitrotoluene had some toxic effects and that these were of similar character as observed with other aromatic nitro compounds . . ."

Gleason reports "liver injury may be more common than cyanosis, especially if diet is deficient in protein." The injury is noted as being necrosis.

Spector gives a cat oral MLD of 27 mg/kg. As noted above, ILO considers the cyanosis and anemia hazard of the substance to be considerable. Indeed, only one other of the 11 nitro compounds listed is given as high a hazard rating for the anemia hazard.

As for the other similar compounds, it is concluded that classifications of 1 and 5 are most appropriate for this substance.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

- National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1975 (NFPA)
- Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-93 (MCA)
- E. I. duPont de Nemours and Co., Material Safety Data Sheet (duP)
- "Lange's Handbook of Chemistry," 11th edition (Lange)
- Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 13, p. 851 (K-O)
- Factory Mutual Engineering Corp., "Handbook of Industrial Loss Prevention," 2nd edition, 1967 (FM)

Sources of data items used:

- I. A. 1. Synonyms: MCA
2. Formula: MCA
3. Molecular weight: Lange
- B. 1. Boiling point: MCA, duP
2. Specific gravity: MCA, Lange, NFPA-325M, K-O
3. Vapor density: Not applicable
4. Melting point: K-O, Lange
5. Vapor pressure: DuP
6. Solubility in water: MCA, Lange, K-O
7. Evaporation rate: Not available
8. Appearance and odor: NFPA-49, MCA
- II. A. 1. Flash point: NFPA-325M
2. Autoignition temperature: duP
3. Impact sensitivity: K-O
4. Flammable limits: Not applicable
5. Extinguishing media: MCA; FM
6. Special fire fighting procedures: NFPA-49, MCA
7. Unusual fire and explosion hazards: NFPA-49, duP
- B. 1. Conditions contributing to instability: MCA, DuP
2. Incompatibilities: duP, MCA

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- 3. Hazardous decomposition products: duP
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: MCA
- C. Waste disposal method: MCA, duP
- V. Miscellaneous precautions: NFPA-49, MCA

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- Baskin, A. D. - editor, "Handling Guide for Potentially Hazardous Commodities," Railway Systems and Management Assoc., 1972 (Baskin)
- "Dinitrotoluene," Chemical Engineering, 81(8), 89, 1974 (Chem Eng)
- "Dinitrotoluene," E. I. duPont de Nemours Co., Material Safety Data Sheet (duPont MSDS)
- "Dinitrotoluene," Hazard Process Index, Hazard Entry No. 68, NIOSH-HSM-99-73-62 (HPI)
- "Dinitrotoluene," Manufacturing Chemists' Association, Chemical Safety Data Sheet SD-93, 1966 (MCA)
- International Labour Organization, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience, 2nd edition, 1972 (K-O)
- Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)

References for Specific Use/Exposure

- 1. Chem Eng, K-O, HPI, SRI
- 2. Chem Eng, HPI, K-O, Baskin, MCA
- 3. Chem Eng, HPI, Baskin, K-O, SRI
- 4. Chem Eng, K-O, HPI
- 5. HPI, K-O

References for Specific Control Methods

duPont MSDS, MCA, ILO and HPI were the references used in all the Specific Control Methods.

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RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Dinitrotoluene

D. O. L. STANDARD: 1.5 mg/M3

WARNING PROPERTIES:

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

Eye Irritation Level: Grant states that "a severe burn of the skin, eyelids, and cornea of one eye, with permanent scarring, has been attributed in one instance to hot fumes of dinitrotoluene." There is no quantitative information available concerning the concentrations which would produce these effects. For the purposes of this standard, half-facepiece respirators are permitted up to a concentration which is 10 times the permissible exposure limit.

Evaluation of Warning Properties: Since there is no quantitative information available relating the warning properties of dinitrotoluene to air concentration, this substance is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

IDLH: 200 mg/M3

Basis for IDLH Value: Since there are no acute inhalation toxicity data available concerning the physiological response to DNT, the chosen IDLH (200 mg/M3) has been estimated from the oral cat MLD value of 27 mg/kg given by Spector.

Other Toxicological Information: The Manufacturing Chemists' Association (MCA) states that "inhalation exposure is not likely to be a problem unless DNT is being handled in the heated molten state without respiratory protection. Under such circumstances sufficient chemical could be absorbed through the lungs to result in methemoglobinemia." MCA points out that DNT can be absorbed rapidly through the intact skin and can produce toxic effects.

The Documentation of TLV's states that "early symptoms resulting from exposure to this material include headache, fatigue, nausea, vomiting, marked chest pain and loss of weight. More advanced symptoms are jaundice and secondary anemia.

"Von Oettingen concluded, in reviewing data from animal experiments conducted by others, that dinitrotoluene had some toxic effects and that these were of similar character as observed with other aromatic nitro compounds but become manifest only after the absorption of larger quantities. By analogy with the limits recommended for nitro and dinitro-benzenes, the limit of 1.5 mg/M3 is adopted."

Gleason states that the toxicity of dinitrotoluene is "irregular but said to be much lower than dinitrobenzene. As in TNT poisoning, each (and all) of the following signs has been observed: methemoglobinemia, anemia, leucopenia, and liver necrosis. Liver injury may be more common than cyanosis, especially if diet is deficient in protein."

There are no acute inhalation toxicity data available concerning the effects of DNT. Spector gives an oral cat MLD of 27 mg/M3, for 2,4-dinitrotoluene and the NIOSH Toxic Substances List gives the following oral data:

Oral LD50 Value for the Isomers of Dinitrotoluene

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Isomer	Animal	LD50 (mg/kg)
2,3-Dinitrotoluene	rat	1122
	mouse	1072
2,4-Dinitrotoluene	rat	268
	mouse	1625
2,5-Dinitrotoluene	rat	707
	mouse	1231
2,6-Dinitrotoluene	rat	177
	mouse	1000
3,4-Dinitrotoluene	rat	177
	mouse	1414

VAPOR PRESSURE AT 20 C: 1 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 1316 ppm (9780 mg/M3)

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid or solid during use for the manufacture of toluenediisocyanate (used for production of polyurethane plastics)	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices); good personal hygiene practice
2.	Inhalation of vapor and skin contact with liquid or solid during manufacture and distribution and during maintenance of equipment and storage containers	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices); good personal hygiene practice
3.	Inhalation of vapor and skin contact with liquid or solid during use in military and some commercial explosives: used to plasticize cellulose nitrate in moderate and high explosives; to moderate burning rate of propellants and explosives; used in manufacture of gelatin explosives (less sensitive to shock and friction); used as a water proofing coating for some smokeless powders; intermediate in the manufacture of TNT	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices); good personal hygiene practice
4.	Inhalation of vapor and skin contact with liquid or solid during use for the manufacture of azo dye intermediates (4-nitro-p-toluidine - Scarlet G base, m-toluenediamine - for fur and hair dyes)	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, goggles, respiratory protective devices); good personal hygiene practice
5.	Inhalation of vapor and skin contact with liquid or solid during use for organic synthesis (pre-	A,B,D	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective

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paration of toluidines,
dyes, and explosives)

equipment (gloves, goggles,
respiratory protective
devices); 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