

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** DINITROBENZENE, ALL ISOMERS ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DINITROBENZENE, ALL ISOMERS

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 DINITROBENZENE, ALL ISOMERS.

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 dinitrobenzene (all isomers) not in excess of 1 milligram 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 dinitrobenzene.

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

(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 dinitrobenzene;

(ii) Any measurements of dinitrobenzene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to dinitrobenzene; 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 dinitrobenzene 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 dinitrobenzene 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 dinitrobenzene 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 dinitrobenzene 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 dinitrobenzene 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 dinitrobenzene 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
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Above permissible exposure	$\pm 25\%$
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At or below permissible exposure and above the action level	$\pm 35\%$
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At or below the action level	$\pm 50\%$
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(d) Compliance. (1) No employee shall be exposed to dinitrobenzene above the permissible exposure as defined in paragraph (a)(1) of this section.

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

(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 dinitrobenzene 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 DINITROBENZENE (ALL ISOMERS)

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION

Particulate Concentration	
5 mg/M3 or less	Any dust and mist respirator, except single use.
10 mg/M3 or less	Any dust and mist respirator, except single-use or quarter mask respirator.
	Any fume respirator or high efficiency particulate filter respirator.
	Any supplied-air respirator.
	Any self-contained breathing apparatus.
50 mg/M3 or less	A high efficiency particulate filter respirator with a full facepiece.
	Any supplied-air respirator with a full facepiece, helmet or hood.
	Any self-contained breathing apparatus with a full facepiece.
200 mg/M3 or less	A powered air-purifying respirator with a high efficiency particulate filter.
	A Type C supplied-air respirator operated in pressure demand or other positive pressure or continuous-flow mode.
Greater than 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

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	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 dust and mist respirator, except single-use. Any escape self-contained breathing apparatus.

(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 dinitrobenzene.

(2) For the purpose of compliance with § 1910.109, dinitrobenzene is classified as a Class A explosive.

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

(4) Dinitrobenzene shall be stored so as not to come in contact with strong oxidizers, caustics and 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 skin contact with dinitrobenzene or liquids containing dinitrobenzene, where skin contact may occur. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

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

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

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

(5) Employers shall ensure that non-impervious clothing which becomes wet with liquids containing dinitrobenzene be removed immediately and that non-impervious clothing which becomes contaminated with dinitrobenzene be removed promptly and such clothing shall not be reworn until the dinitrobenzene is removed from the clothing.

(6) Employers shall provide and ensure that employees use safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133(a)(2)-(a)(6) where dinitrobenzene or liquids containing dinitrobenzene may contact the eyes.

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(g) Spills and disposal. In the event that dinitrobenzene 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 liquids containing dinitrobenzene immediately wash or shower with soap or mild detergent and water to remove any dinitrobenzene from the skin.

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

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

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

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

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

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

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

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

(2) Preplacement medical examination. The employer shall make available to each employee who is exposed, or will be exposed, to dinitrobenzene or liquids containing dinitrobenzene or airborne concentrations of dinitrobenzene at or above the action level a preplacement medical examination which must include the following:

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

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(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 dinitrobenzene or liquids containing dinitrobenzene or airborne concentrations of dinitrobenzene 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, liver, and eyes;

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 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 including a methemoglobin determination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to dinitrobenzene which are listed in Appendix A which the employee suspects are caused by exposure to dinitrobenzene.

(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 dinitrobenzene;

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

(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 shall be a signed statement by the examining physician 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 dinitrobenzene or would directly or indirectly aggravate any detected medical condition;

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

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

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

(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 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 dinitrobenzene 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 dinitrobenzene.

(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 dinitrobenzene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to dinitrobenzene 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.

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(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 dinitrobenzene;

(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 dinitrobenzene.

(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 dinitrobenzene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to dinitrobenzene requires entry into an area where the use of personal

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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 dinitrobenzene 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 DINITROBENZENE (ALL ISOMERS)

I. SUBSTANCE IDENTIFICATION

A. Substance: Dinitrobenzene

B. Permissible Exposure: 1 milligram of dinitrobenzene per cubic meter of air (mg/M3) averaged over an eight-hour work shift.

C. Appearance: Pale yellow solid

II. HEALTH HAZARD DATA

A. Comment: There are three forms of dinitrobenzene. Dinitrobenzene is often used as a mixture of these forms. The following applies to all three forms.

B. Ways in which the chemical affects your body: Dinitrobenzene 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, either as solid, liquid or vapor. Even a small amount absorbed from the clothes or shoes may cause toxic symptoms.

C. Effects of Overexposure:

1. Short-term Exposure: Dinitrobenzene may affect the ability of blood to carry oxygen. A bluish discoloration of the skin may occur with headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness and unconsciousness. If treatment is not given promptly, death may occur. The onset of symptoms may be delayed. Consuming alcohol may make symptoms worse. Dinitrobenzene may also cause an

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unpleasant taste or burning sensation in the mouth, dry throat and thirst. The eyes, hair and skin may become yellowish. Dinitrobenzene may cause reduced vision. In addition, liver damage may occur. Repeated or prolonged exposure to dinitrobenzene may cause anemia.

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

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If dinitrobenzene or liquids containing dinitrobenzene get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If dinitrobenzene or liquids containing dinitrobenzene get on your skin, immediately wash the contaminated skin using soap or mild detergent skin using soap or mild detergent and water. If dinitrobenzene or liquids containing dinitrobenzene penetrate through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention promptly.
- C. Breathing: If you or any other person breathes in large amounts of dinitrobenzene 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 dinitrobenzene or liquids containing dinitrobenzene have 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 dinitrobenzene. 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

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should not be loosened or removed in work situations where there use is required. 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 skin contact with solid dinitrobenzene or liquids containing dinitrobenzene where skin contact may occur. repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear dust-resistant safety goggles where dinitrobenzene may contact your eyes. You must wear splash-proof safety goggles where liquids containing dinitrobenzene may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Dinitrobenzene is an explosive that may be detonated by heat or shock when confined.

B. Dinitrobenzene must be stored in tightly closed containers in a cool, well ventilated area away from heat, strong oxidizers, caustics and metals such as tin and zinc.

C. Sources of ignition such as smoking and open flames are prohibited wherever dinitrobenzene is handled, used or stored.

D. If your work clothing may have become contaminated with solid dinitrobenzene, you must change into uncontaminated clothing before leaving the work premises.

E. You must immediately remove any non-impervious clothing that becomes wet with liquids containing dinitrobenzene and you must promptly remove any non-impervious clothing that becomes contaminated with dinitrobenzene. This clothing shall not be reworn until the dinitrobenzene is removed from the clothing.

F. If your skin becomes wet with liquids containing dinitrobenzene, you must immediately wash or shower with soap or mild detergent and water to remove the dinitrobenzene from your skin.

G. If your skin becomes contaminated with dinitrobenzene, you must promptly wash or shower with soap or mild detergent and water to remove the dinitrobenzene from your skin.

H. If you are subject to skin contact with dinitrobenzene or liquids containing dinitrobenzene, 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 dinitrobenzene.

I. You must not eat or smoke in areas where dinitrobenzene or liquids containing dinitrobenzene are handled, processed or stored.

J. If you handle dinitrobenzene or liquids containing dinitrobenzene, you must wash your hands 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 dinitrobenzene is used in your work area and for any additional safety and health rules.

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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 dinitrobenzene. In addition, your employer must instruct you in the safe use of dinitrobenzene, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to dinitrobenzene. 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
FOR DINITROBENZENE (ALL ISOMERS)

I. PHYSICAL AND CHEMICAL DATA

- A. Substance Identification
 1. Synonyms: O-dinitrobenzene; 1,2-dinitrobenzene; M-dinitrobenzene; 1,3-dinitrobenzene; P-dinitrobenzene; 1,4-dinitrobenzene
 2. Formula: Ortho: 1,2-C₆H₄(NO₂)₂; meta: 1,3-C₆H₄(NO₂)₂; para: 1,4-C₆H₄(NO₂)₂
 3. Molecular weight: 168.1
- B. Physical Data
 1. Boiling point (760 mm Hg): Ortho: 318 C (604 F); Meta: 300 C (572 F); Para: 297 C (566 F)
 2. Specific gravity (water = 1): Ortho: 1.59; Meta: 1.57; Para: 1.63
 3. Vapor density (air = 1 at boiling point of dinitrobenzene): 5.8
 4. Melting point: Ortho: 117 C (243 F); Meta: 90 C (194 F); Para: 173 C (343 F)

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5. Vapor pressure at 20 C (68 F); All isomers - much less than 1 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Ortho: 0.01; Meta: 0.05; Para: 0.01
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance: Pale yellow solid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: Explodes
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: Data not available
5. Extinguishing media: None.
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 dinitrobenzene should be fought from an explosion-resistant location because of the possibility of detonation of dinitrobenzene. In advanced or massive fires, the area should be evacuated.
7. Unusual fire and explosion hazards: Dinitrobenzene is an explosive. Although somewhat less sensitive to shock than TNT, it can be detonated by shock or heat under confinement. All ignition sources must be controlled where dinitrobenzene is used, handled or stored.
8. For purposes of conforming with the requirements of 29 CFR 1910.109, dinitrobenzene is classified as a Class A explosive.

B. Reactivity

1. Conditions contributing to instability: Dinitrobenzene may detonate when subject to shock or when heated under confinement.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosion. Contact with caustics and metals such as tin and 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 dinitrobenzene.
4. Special precautions: Liquid dinitrobenzene will attack some forms of plastics, rubber and coatings.

III. SPILL AND DISPOSAL PROCEDURES

A. If dinitrobenzene 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

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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.

R. 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 dinitrobenzene 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 dinitrobenzene 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 by collection of the particulates using a high efficiency membrane filter with subsequent chemical analyses. The method of measurement must determine the concentration of dinitrobenzene to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of dinitrobenzene to plus or minus 25%.

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

D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Store dinitrobenzene in accordance with 29 CFR 1910.109.

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B. Employers should advise employees of all areas and operations where exposure to dinitrobenzene could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to dinitrobenzene is likely to occur are: During its production; during its use as an intermediate in the manufacture of dyes and photographic chemicals; and during its use as an organic synthesis intermediate; and as an explosive.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Absorption of any isomer of dinitrobenzene, whether from inhalation of the vapor or dust or skin absorption of the solid, causes anoxia due to the formation of methemoglobin; chronic exposure produces anemia. Exposed workers have complained of an unpleasant taste, burning sensation in the mouth, dry throat, and thirst. 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 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. Until the methemoglobin concentration approaches approximately 40 percent, the individual may feel well, have no complaints, and may insist nothing is wrong. 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. The ingestion of alcohol has been reported to aggravate the toxic effects of dinitrobenzene. Chronic exposure of workers causes anemia; there are scattered reports of liver injury. Visual impairment has been reported in the form of reduced visual acuity and central scotomas, particularly for red and green colors; yellow discoloration of the conjunctiva and sclera is common. Yellow-brown discoloration of the hair and exposed skin of workers has been reported.

III. SIGNS AND SYMPTOMS

Signs of anoxia with cyanosis; reduced visual acuity, central scotomas; unpleasant taste, burning sensation in mouth, dry throat, thirst; yellow discoloration of hair, eyes, skin; anemia; liver damage.

IV. SPECIAL TESTS

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

V. TREATMENT

Remove from exposure. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation if indicated. Any dinitrobenzene 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 any isomer of dinitrobenzene are caused by its capacity to produce cyanosis 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 dinitrobenzene 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 any isomer of dinitrobenzene:

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, cardiovascular system, and eyes should be stressed.
2. A complete blood count -- Dinitrobenzene 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

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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 dinitrobenzene, 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: "Dinitrobenzene (All Isomers)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 92.
2. von Oettingen: 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. 94-103.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2105-2119, 2130-2131, 2138-2140.
4. Lynch, A.L.: "Biological Monitoring for Industrial Exposure to Cyanogenic Aromatic Nitro and Amino Compounds," American Industrial Hygiene Association Journal, 35:426-432, 1974.
5. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles C. Thomas, Springfield, Illinois, 1974, pp. 409-410.
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

DINITROBENZENE

1910.1000

- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: Von Oettingen, "Poisoning;" Grant, "Toxicology of the Eye;"
- Skin: International Labour Office, "Encyclopedia of Occupational Health and Safety;" Baskin, "Handling Guide for Potentially Hazardous Commodities," Railway Systems and Management Association; Schwartz, Tulipan and Birmingham, "Occupational Diseases of the Skin;" National Fire Protection Association, "National Fire Codes," Vol. 3, "Combustible Solids, Dusts and Explosives;" Sax, "Dangerous Properties of Industrial Materials;" Patty, "Industrial Hygiene and Toxicology;" American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" Grant, "Toxicology of the Eye;" Stauden, "Kirk-Othmer Encyclopedia of Chemical Technology;" Hunter, "The Diseases of Occupations"
- Ingestion: Gleason, Gosselin, Hodge and Smith, "Clinical Toxicology of Commercial Products," Third edition; Patty, "Industrial Hygiene and Toxicology;" Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" Spector, Negherbon, Grebe and Dittmer, "Handbook of Toxicology"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10 and 12 combined

Exceptions: None

Grant reports "surface contact may cause yellowing of the skin, and purportedly of the conjunctiva and cornea, but no original observations on corneal changes were found in the literature." He adds that "in experiments on hypersensitivity to chemicals, it has been determined that in guinea pigs with dermal hypersensitization to 2,4-dinitrobenzene, there was not inflammatory response when this substance was brought into contact with the uveal tract, retina, or conjunctiva." According to Von Oettingen, local contact with dinitrobenzene results in "yellow discoloration of the conjunctiva and sclera."

Based on the discoloration effect cited, a classification of 2 is assigned and safety goggles are required where dinitrobenzene or liquids containing dinitrobenzene may contact the eyes.

Skin - Classification: 1 and 5

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

Exceptions: See below

On a scale of 1 (slight) to 6 (severe), ILO lists the cyanosis hazard of this compound as a 1, the anemia hazard as a 4, and the overall toxic hazard as a 1. In general it states "the acute health hazard of the aromatic nitrocompounds is cyanosis and the chronic manifestation is anemia."

The Documentation of TLV's suggests that the dinitro

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derivatives of benzene are more toxic acutely by a factor of at least five than the mononitro derivatives.

Baskin reports that repeated or prolonged exposure from skin absorption may produce weight loss, anemia, weakness and irritability. The symptoms of acute poisoning from skin absorption are, "cyanosis, headache, shallow breathing, dizziness, confusion, drop in blood pressure, convulsions and coma." Later, symptoms of "jaundice, painful urination or anemia" may appear.

Schwartz, Tulipan and Birmingham list dinitrobenzene as a primary skin irritant.

The NFPA says that dinitrobenzene is "extremely toxic" by absorption, sometimes with delayed effects, and can also "cause liver injury."

Patty reports that "even though of comparatively low vapor pressure, it appears so much more toxic than aniline and nitrobenzene. Comparable exposure to or absorption of this compound results in a more intensive methemoglobinemia, which is much less readily reversible than that from an equivalent exposure to its parent compound, nitrobenzene." He adds, "even though it is a solid, (it) is a methemoglobin - former par excellence."

Hunter gives an account of an experiment Hay conducted upon himself. In this experiment, Hay anointed his groins with 0.1 grams of DNB in 400 mg of an ointment in the morning and evening of one day and in the morning of the next. He recounts "at 12 noon, owing to the cyanosis increasing in intensity, I carefully washed off all the ointment. At 1 p.m. the lips were a livid blue and the nails and skin generally of a deadly hue. There was a feeling of fullness in the head and some throbbing headache, increased by movement." Additionally, his pulse was 100 to 120. By that evening, he had developed tremors and the veins of the hands and ears were "full and engorged." The pulse was 96 to 98. On the third day following his initial exposure, his "health was practically normal, with the exception of a slight tendency to headache."

The Documentation of TLV's notes that "ready absorption of DNB through the skin is a well emphasized factor in the toxicity and hazard of this substance."

Stauden reports, "it is considered unsuitable for handling on a mass-production basis and should be handled with care even on a laboratory scale. Contact of dinitrobenzene solution with the skin particularly should be avoided."

Grant reports that "surface contact may cause yellowing of the skin."

Sax considers the acute and chronic effects of skin absorption to be of high toxic hazard. 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

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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 the production of acute yellow atrophy, toxic hepatitis, and fatty degeneration of the kidneys."

The melting points of the three isomers vary from 194 to 343 degrees F. All have a vapor pressure at 20 degrees C which is much less than 1 mm Hg and range in solubility in water from 0.01 to 0.05%.

To prevent these effects, it is concluded that overall classifications of 1 and 5 are most appropriate. However, because of the hazards and properties of the substance, the following exceptions are made. Statement 2 is modified to prevent contact where it "may occur." Statement 8b is used 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 and Stauden. Similarly, statements 14g and 14i are used when 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

According to Gleason, the nitro compound "meta isomer is said to be the most important toxicologically, especially as a methemoglobin former. The principal symptom is cyanosis."

Patty reports strong methemoglobin formation, which on prolonged exposure "may lead to liver damage."

Deichmann and Gerarde give symptoms of ingestion and "anemia, cyanosis, gastroenteric disturbances, injury to liver and neuritis." They say also that the "meta isomer is more toxic than the ortho and para because it is more potent in converting hemoglobin to methemoglobin."

Spector gives an LD50 for the cat of 29.9 mg/kg at which death occurred in 24 hours, and Deichmann and Gerarde give the "probable lethal dose for an adult" at 2 gm.

Because the degree of methemoglobin formation is so strong, and the danger of liver damage, classifications of 1 and 5 are concluded to be appropriate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

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

Eastman Kodak Co., Material Safety Data Sheet (EKC)

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

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 2, p. 425; Vol. 15, p. 216 (K-O)

"Beilstein's Handbuch der Organischen Chemie," Vol. I, p. 261 and supplements (Beil)

Sources of data items used:

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- I. A. 1. Synonyms: Lange
2. Formula: Lange
3. Molecular weight: Lange
- B. 1. Boiling point: NFPA-325M, Lange, EKC
2. Specific gravity: Lange
3. Vapor density: Calculated
4. Melting point: NFPA-325M, NFPA-49, Lange
5. Vapor pressure: EKC, data not available
6. Solubility in water: Lange, EKC, Beil
7. Evaporation rate: Not applicable
8. Appearance and odor: NFPA-49, ADL
- II. A. 1. Flash point: Not applicable
2. Autoignition temperature: Data not available
3. Impact sensitivity: K-0
4. Flammable limits: Data not available
5. Extinguishing media: EKC, ADL
6. Special fighting procedures: NFPA-49
7. Unusual fire and explosion hazards: NFPA-49, EKC
- B. 1. Conditions contributing to instability: EKC, ADL
2. Incompatibilities: ADL, analogy with other nitroaromatics
3. Hazardous decomposition products: EKC
4. Special precautions: ADL
- III. A. Steps if released or spilled: Analogy to dinitrotoluene
C. Waste disposal method: Analogy to dinitrotoluene
- V. Miscellaneous precautions: NFPA-49, ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- "Chemical Origins and Markets, Flow Charts and Tables," 4th edition, Stanford Research Institute, 1967 (Chem Origins)
- "meta-Dinitrobenzene," Hygienic Guide Series, American Industrial Hygiene Association, Feb. 1959 (Hyg. Guide)
- "Dinitrobenzene," Material Safety Data Sheet, Eastman Kodak Co., July 26, 1973 (MSDS)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," 2nd edition, Interscience Publishers, 1972 (K-O)
- Mark, H. F., Gaylord, N. G. and Bikales, N. M., "Encyclopedia of Polymer Science and Technology," Interscience Publishers, 1964 (Poly. Sci.)
- Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)

References for Specific Use/Exposure

- 1. Chem. Origins, Hyg. Guide, K-O
- 2. Chem. Origins, K-O, Patty
- 3. K-O
- 4. Patty, Poly. Sci.
- 5. MSDS
- 6. K-O

-References for Specific Control Methods

- Hyg. Guide and MSDS were the references used in numbers 1 - 5.
- 6. K-O

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RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Dinitrobenzene (all isomers)

D. O. L. STANDARD: 1 mg/M3

Eye Irritation Level: Grant states that "surface contact (with dinitrobenzene) may cause yellowing of the skin, and purportedly of the conjunctiva and cornea, but no original observations on corneal changes were found in the literature." According to Grant, "2,4-dinitrobenzene caused no inflammatory response when this substance was brought into contact with the uveal tract, retina, or conjunctiva" of guinea pigs.

For the purposes of this standard, quarter- and half-facepiece respirators are permitted.

IDLH: 200 mg/M3

Basis for IDLH Value: There are no acute inhalation toxicity data available upon which to base an IDLH concentration for dinitrobenzene. The chosen IDLH, therefore, has been estimated from the statement by Deichmann and Gerarde that "the probable lethal oral dose for an adult is 2 gm."

Other Toxicological Information: Deichmann and Gerarde note that "absorption (of dinitrobenzenes) may cause anemia, cyanosis, gastroenteric disturbances, injury to the liver, and neuritis. The meta isomer is more toxic than the ortho and para because it is more potent in converting hemoglobin to methemoglobin. The probable lethal oral dose for an adult is 2 gm." Patty reports that o-dinitrobenzene can be absorbed through the intact skin readily.

The NIOSH Toxic Substances List gives oral cat LDLo's of 27 mg/kg for n-dinitrobenzene and 29 mg/kg for p-dinitrobenzene.

The Documentation of TLV's states that "a vast history of industrial experience with DNB poisoning was reported by von Oettingen and Hunter. This experience indicated DNB to be a highly toxic substance, exhibiting various signs and symptoms of involvement of the blood, although fatalities rarely occurred from exposure. Ready absorption of DNB through the skin is a well emphasized factor in the toxicity and hazard of this substance. Unfortunately, no reference to the degree of exposure which produced these symptoms is to be found in these historical reviews. Moreover, currently there are no published reports, either on man or in animals, at measured levels of exposure. The basis for setting the limit for DNB must, therefore, be arrived at on the basis of an estimate of the comparative toxicities of polynitro aromatic compounds relative to those of the mononitro derivatives.

"Comparative acute LD50 values for the dinitro aromatic derivatives and the corresponding mononitro compounds by various routes in various animals show almost without exception that the dinitro compounds are more acutely toxic by a factor of at least five. The LD50 values for the dinitro derivatives of benzene, toluene, phenol, o-cresol and alpha-naphthol range from 5 to 60 mg/kg, classifying these substances in the 'highly toxic' category on an acute basis; the LD50 values available for the corresponding mononitro derivatives, benzene, toluene and phenol, range from 20 - 1000 mg/kg or greater.

"Accordingly, a threshold limit for the dinitrobenzene isomers of 1 mg/M3 is recommended. This value has also been adopted by the

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USSR and Czechoslovakia."

VAPOR PRESSURE AT 20 C: All isomers: Much less than 1 mm Hg

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Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor and skin contact with crystals during use in the dye industry - preparation of dyes and dye intermediates (m-phenylenediamine, m-nitroaniline, picric acid)	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
2. Inhalation of vapor and skin contact with crystals during use in the chemical industry as an organic synthesis intermediate (2,4-diaminophenol - photographic developers, trinitrobenzene - explosives)	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
3. Inhalation of vapor and skin contact with crystals during the synthesis and processing of dinitrobenzene (nitration of nitrobenzene using sulfuric acid and fuming nitric acid). The second nitro group is meta-directed producing a mixture of 91 - 94% meta-dinitrobenzene and the rest ortho- and para-dinitrobenzene. For this reason the meta isomer is the most important.	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
4. Inhalation of vapor and skin contact with crystals during use in the plastics industry (camphor substitute in the production of celluloid, polymerization inhibitor - retards allyl acetate polymerization)	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment (goggles, gloves, respiratory protective devices)
5. Inhalation of vapor and skin contact with crystals during cleaning and maintenance of storage vessels	A,B,D	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

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and during clean up of
accidental spills

(goggles, gloves, respira-
tory protective devices)

6. Skin contact with crystals
during use as an explosive
(substitute for TNT and
other explosives in shells
and generally mixed with
ammonium nitrate or
other high explosives). Be-
cause of its toxicity
and the availability of
more powerful explosives,
it is no longer of practical
importance.

B,D

Material substitution

- A -- Inhalation
- B -- Skin and eye contact resulting
in localized irritation
- C -- Ingestion
- D -- Skin contact resulting in
absorption and subsequent
systemic poisoning