NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** NITROBENZENE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for NITROBENZENE

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 NITROBENZENE.

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.

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of nitrobenzene not in excess of 1 part per million (ppm) (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 nitrobenzene.

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

(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 nitrobenzene;

(ii) Any measurements of nitrobenzene taken;

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

(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 nitrobenzene above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of nitrobenzene 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. (i) 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 nitrobenzene.

(ii) In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving nitrobenzene shall be classified as A-4 at 70 degrees F (21 degrees C.)

(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

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

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION*
Vapor Concentration	
10 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
50 ppm or less	A chemical cartridge respirator with a full facepiece, and organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
200 ppm 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 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied - air respirator with a full facepiece operated in pressure - demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece

	operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors.
	Any escape self-contained breathing apparatus.

*Use of supplied-air suits may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of nitrobenzene. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitation and potential life endangering characteristics of supplied-air suits. Where supplied-air suits are used above a concentration which may be immediately dangerous to life and health (200 ppm), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for nitrobenzene.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of nitrobenzene shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, nitrobenzene 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 nitrobenzene shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid nitrobenzene is classified as a Class IIIA combustible liquid.

(6) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(7) Where a fan is located in ductwork and where nitrobenzene is present in the ductwork in concentrations greater than 4500 ppm (approximately 25% of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

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

(9) Nitrobenzene shall be stored so as not to come in contact with strong oxidizers (especially concentrated nitric acid or nitrogen tetroxide), caustics and chemically active 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 liquid nitrobenzene. Face shields shall comply with § 1910.133 (a)(2), (a)(4),(a)(5), and (a)(6).

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

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

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

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

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

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

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

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

(3) Employers shall ensure that employees do not eat or smoke in areas where liquid nitrobenzene is handled, processed or stored.

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

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

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

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

(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 liquid nitrobenzene or airborne concentrations of nitrobenzene 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, kidneys, heart, and skin;

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

(3) Periodic medical examination. The employer shall make available to each employee exposed to liquid nitrobenzene or airborne concentrations of nitrobenzene 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, kidneys, heart and skin;

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

(4) Alternative medical procedures. If the examining physician chooses to use alternative medical 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 a methemoglobin determination for the employee if the employee informs the employer of any of the signs or symptoms of exposure to nitrobenzene which are listed in Appendix A which the employee suspects are caused by exposure to nitrobenzene.

(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 nitrobenzene:

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

(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:

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

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

(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 blood tests;

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

(10) No employee shall be exposed to nitrobenzene 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 nitrobenzene.

(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 nitrobenzene.

(ii) This record shall include:

(A) The date of measurement;

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

(C) Sampling and analytical method used and evidence of their accuracy;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) The name and social security number of the employee;

(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 nitrobenzene;

(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 nitrobenzene.

(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.

(l) Employee observation of measurement. (1) The employer shall give each employee or his representative an opportunity to observe any measurement of his exposure to nitrobenzene which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to nitrobenzene 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 nitrobenzene 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 NITROBENZENE

I. SUBSTANCE IDENTIFICATION

A. Substance: Nitrobenzene

B. Permissible Exposure: 1 part of nitrobenzene per million parts of air (ppm) (5 milligrams of nitrobenzene per cubic meter of air (mg/M3)) averaged over an eight-hour work shift.

C. Appearance and Odor: Pale yellow to dark brown oily liquid with an odor like black paste shoe polish. It can be a solid at temperatures below 5.1 C (41 F).

II. HEALTH HAZARD DATA

A. Ways in which the chemical affects your body: Nitrobenzene 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 a liquid or

vapor. Even a small amount absorbed from the clothes or shoes may cause toxic symptoms.

B. Effects of Overexposure:

1. Short-term Exposure: Nitrobenzene affects 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. Direct contact with the eyes or skin may cause mild irritation. Ingestion of alcohol may cause aggravation of symptoms.

2. Long-term Exposure: Repeated or prolonged exposure to nitrobenzene may cause anemia. An allergic skin rash may occur.

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 nitrobenzene.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If liquid nitrobenzene gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If liquid nitrobenzene gets on your skin, immediately wash the contaminated skin using soap or mild detergent and water. If liquid nitrobenzene soaks 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 nitrobenzene move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

D. Swallowing: When liquid nitrobenzene 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 nitrobenzene. You can only be required to wear them for routine use if your employer is in the process of

installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you can smell nitrobenzene 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. Supplied-air suits: In some work situations the wearing of supplied-air suits may be necessary. Your employer should instruct you in their proper use and operation.

C. Protective Clothing: You must wear impervious clothing gloves, face shield or other appropriate protective clothing to prevent any possibility of skin contact with liquid nitrobenzene. Replace or repair impervious clothing that has developed leaks.

D. Eye Protection: You must wear splash-proof safety goggles where liquid nitrobenzene may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Nitrobenzene is a combustible liquid and its vapors can form explosive mixtures with air at elevated temperatures.

B. Nitrobenzene must be stored in tightly closed containers in a cool, well-ventilated area away from strong oxidizers (especially concentrated nitric acid or nitrogen tetroxide), caustics and chemically active metals such as tin and zinc.

C. Sources of ignition such as smoking and open flames are prohibited wherever nitrobenzene is handled, used or stored in a manner that could create a potential fire or explosion hazard.

D. If your work clothing has had any possibility of being contaminated with solid nitrobenzene, you must change into uncontamined clothing before leaving the work premises.

E. You must immediately remove any non-impervious clothing that becomes contaminated with nitrobenzene and this clothing must not be reworn until the nitrobenzene is removed from the clothing.

F. If your skin becomes contaminated with nitrobenzene, you must wash or shower with soap or mild detergent and water to remove any nitrobenzene from your skin.

G. If you are subject to skin contact with liquid nitrobenzene, 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 nitrobenzene.

H. You must not eat or smoke in areas where liquid nitrobenzene is handled, processed or stored.

I. If you handle liquid nitrobenzene, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

J. Fire extinguishers and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.

K. Ask your supervisor where nitrobenzene 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 nitrobenzene. In addition, your employer must instruct you in the safe use of nitrobenzene, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to nitrobenzene. 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 NITROBENZENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Nitrobenzol; oil of mirbane
2. Formula: $C_6H_5NO_2$
3. Molecular weight: 123.1

B. Physical Data

1. Boiling point (760 mm Hg): 211 C (412 F)
2. Specific gravity (water = 1): 1.2
3. Vapor density (air = 1 at boiling point of

nitrobenzene): 4.3

4. Melting point: 5.1 C (41 F)
5. Vapor pressure at 20 C (68 F): Much less than 1 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.19
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Pale yellow to dark brown oily liquid with an odor like black paste shoe polish. It can be a solid at temperatures below 5.1 C (41 F).

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 88 C (190 F) (closed cup)
2. Autoignition temperature: 482 C (900 F)
3. Flammable limits in air, % by volume at 200 F): Lower: 1.8
4. Extinguishing media: Dry chemical, foam, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Nitrobenzene is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where nitrobenzene is used, handled or stored in a manner that could create a potential fire or explosion hazard.
7. For purposes of complying with the requirements of 29 CFR 1910.106, nitrobenzene is classified as a Class IIIA combustible liquid. For example, 4500 ppm, approximately one-fourth of the lower flammable limit, is one situation in which nitrobenzene is considered to be a potential fire and explosion hazard.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electric Code for nitrobenzene shall be Class I, Group D.

B. Reactivity

1. Conditions contributing to instability: None
2. Incompatibilites: Contact with concentrated nitric acid or nitrogen tetroxide may cause fires and explosion. Contact with caustic and with chemically active metals such as tin and zinc can cause evolution of much heat and fumes.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving nitrobenzene.
4. Special precautions: Liquid nitrobenzene will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If liquid or solid nitrobenzene is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. If in the liquid form, for small quantities, absorb on paper towels. Remove to a safe place (such as a fume

hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

3. If in the solid form, allow to melt and handle as indicated in (2.) above.

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

C. Waste disposal methods: Nitrobenzene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in sealed containers in a secured sanitary landfill.

2. By 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 collection of the particulates and vapors using a high efficiency membrane filter followed by an adsorption tube with subsequent chemical analysis of both filter and adsorption tube. Detector tubes certified by NIOSH under 42 CFR part 84 or other direct-reading devices calibrated to measure nitrobenzene may be used. The method of measurement must determine the concentration of nitrobenzene to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be exxentially 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 nitrobenzene 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 nitrobenzene in tightly closed containers in a cool, well ventilated area.

B. When working in high airborne concentrations of nitrobenzene, use of supplied-air suits or other impervious coverings may be necessary to prevent skin absorption. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.

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

VI. COMMON OPERATIONS

Common operations in which exposure to nitrobenzene is likely to occur are: During its production; during its use as a special solvent in refining lubricating oils; and during its use as an intermediate in the manufacture of aniline, dyes, rubber chemicals, photographic chemicals, explosives, insecticides, and germicides.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Nitrobenzene absorption, whether from inhalation of the vapor or absorption of the liquid through skin, causes anoxia due to the formation of methemoglobin; chronic exposure produces anemia. In rabbits given subcutaneous injections of 0.75 g of nitrobenzene there was methemoglobin, sulfhemoglobin, Heinz body formation in erythrocytes, a marked decrease in hematocrit and hemoglobin levels, reticulocytosis, and mild damage to the liver and kidney. Vapor concentrations near 40 ppm resulted in intoxication of workers; exposure to vapor concentrations averaging 6 ppm caused headache and vertigo; small amounts of methemoglobin and sulfhemoglobin and some Heinz bodies were found in the blood. 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 often. Cyanosis develops early in the course of intoxication, first in the lips, the nose, and the ear lobes, often recognized by fellow workers. Cyanosis often occurs when the methemogoblin concentration is 15 percent of more. The individual may feel well, have no complaints, and may insist that nothing is wrong until the methemoglobin concentration 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 aggravates the

toxic effects of nitrobenzene. p-Nitrophenol and p-aminophenol are metabolites of nitrobenzene and their presence in the urine is an indication of exposure. Nitrobenzene is mildly irritating to the eyes; it may produce dermatitis due to primary irritation or sensitization.

III. SIGNS AND SYMPTOMS

Signs of anoxia due to methemoglobin formation; eye irritation; dermatitis; anemia; by analogy to effects caused in animals there may be liver and kidney damage.

IV. SPECIAL TESTS

Determination of methemoglobin concentration in the blood when nitrobenzene intoxication is suspected, and at regular intervals until the methemoglobin has been fully reduced to normal hemoglobin. The presence of p-nitrophenol and p-aminophenol in the urine is an indication of exposure.

V. TREATMENT

Remove from exposure. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation if indicated. Any nitrobenzene 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 nitrobenzene 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 may be the major route of entry. It is important that the physician become familiar with plant operating conditions in which exposure to nitrobenzene 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 nitrobenzene:

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, kidneys, and cardiovascular system should be stressed. Skin should be examined for chronic disorders.

2. A complete blood count -- Nitrobenzene has been shown to cause methemoglobinemia and may cause anemia. Those with blood disorders may be at increased risk from exposure. A complete blood count must be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit. Observe for Heinz bodies.

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: "Nitrobenzene," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 183.

2. Hygienic Guide Series: "Nitrobenzene," American Industrial Hygiene Association Journal, 20:66-67, 1959.

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, 2146-2147.

4. Manufacturing Chemists Association, Inc.: Chemical Safety Data Sheet SD-21, Nitrobenzene, Washington, D.C., 1967, pp. 5-6, 12-14.

5. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, New York, 1965, pp. 298-303.

6. Ikeda, M. and A. Kita: "Excretion of p-Nitrophenol and p-Aminophenol in the Urine of a Patient Exposed to Nitrobenzene," British Journal of Industrial Medicine, 21:210-213, 1964.

7. Linch, A.L.: "Biological Monitoring for Industrial Exposure to Cyanogenic Aromatic Nitro and Amino Compounds," American Industrial Hygiene Association Journal, 35:426-432, 1974.

8. International Labour Office: Encyclopaedia of Occupational Health and Safety, Vol. II, L-Z, McGraw Hill Book Company, New York, 1974, pp. 940-944.

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

REFERENCES AND SOURCES
NITROBENZENE
1910.93

(d) Compliance - Open surface tank classification based on relative evaporation rate of 370 hours (from Doolittle)

(f) Personal Protective Equipment, and, (h) Sanitation

Eye: Grant, "Toxicology of the Eye;" Browning, "Toxicity and Metabolism of Industrial Solvents;" Manufacturing Chemists' Association, "Manual Sheet SD-21"

Skin: Manufacturing Chemists' Association, "Manual Sheet SD-21;" American Conference of Governmental Industrial Hygienists, "Documentation of Threshold Limit Values;" AIHA Hygienic Guide Series; Patty, "Industrial Hygiene and Toxicology;" Browning, "Toxicity and Metabolism of Industrial Solvents;" Fairhall, "Industrial Toxicology;" Johnstone and Miller, "Occupational Diseases and Industrial Medicine;" "NIOSH Toxic Substances List 1974"

Ingestion: Fairhall, "Industrial Toxicology;" Van Oettingen, "Poisoning;" Browning, "Toxicity and Metabolism of Industrial Solvents;" Chambers and O'Neill, "Nitrobenzene Poisoning," (BJIM); Patty, "Industrial Hygiene and Toxicology;" Sax, "Dangerous Properties of Industrial Materials;" Manufacturing Chemists' Association, "Manual Sheet SD-21;" Gleason, "Clinical Toxicology of Commercial Products;" Thienes and Haley, "Clinical Toxicology"

COMMENTS

Eye - Classification: 2
Output statement numbers: 10
Exceptions: None

According to Grant, the ocular effects of nitrobenzene are secondary to systemic poisoning rather than the result of direct contact with the eyes. The only toxic effect observed was "brown discolorations of the vessels of the fundus and the conjunctiva," caused by the hemoglobin of the blood being converted into methemoglobin. Grant further notes that information relating to the toxic effect on the eyes has not been reliable, because in most industrial accidents, other mixtures of substances are evolved along with nitrobenzene. It has been claimed that nitrobenzene has "caused diminution of central visual acuity, contraction of visual fields, and rarely, central scotoma."

Browning reports "only slight transient irritation" attributed to nitrobenzene, while the MCA notes "nitrobenzene is mildly irritating to the eyes and corneal damage may occur."

There is no indication that the substance causes any sort of permanent effect in direct contact with the eye. It is, therefore, assigned a classification of 2.

Skin - Classification: 1
Output statement numbers: 1, 5a, 6, 14g, 14i, 15, 20a
Exceptions: See below

The MCA reports that nitrobenzene is an extremely hazardous liquid and is "highly toxic when absorbed through the skin."

According to the ACGIH, "Piotrowski estimated that if a worker were exposed all day at the TLV of 1 ppm, approximately 25 mg of nitrobenzene would be absorbed, of which about one-third would be by skin absorption." The AIHA notes that it "may be almost immediately fatal if significant areas of body are in contact with liquid or clothing saturated with liquid."

Patty states, "clinically, upon appreciable absorption of nitrobenzene, methemoglobinemia is the outstanding effect." Nitrobenzene penetrates the intact skin rapidly because it is a fat-soluble compound. According to the MCA, "significant absorption continues as long as the oily liquid remains on the skin surface or as long as contaminated articles of clothing are worn."

Patty further states that the "rate of appearance of methemoglobinemia is dependant upon the nature of the exposure and its intensity." Delay is expected if absorption takes place slowly; on the other hand, "drenching a man from head to foot with nitrobenzene, little time elapses before cyanosis appears."

Browning states "several industrial cases of poisoning by skin contamination have been reported. A severe case is described in which the poisoning resulted from the use of buckets containing nitrobenzene instead of mechanical delivery in the manufacture of a dye." In this case, the victim recovered in 10 days. In another case, contamination of protective clothing occurred above knee-length rubber boots, the victim complained three and a quarter hours later of "vomiting, breathlessness and was cyanosed;" the victim later recovered.

Fairhall also reports poisoning from clothing wet with nitrobenzene and claims it is the most likely source of industrial poisoning.

Johnstone and Miller record a case history whereby a "chemist's assistant spilled nitrobenzene on his trousers and almost at once fell on the floor. He was rushed to the hospital in his soaking clothes and was unconscious when he arrived, with respiration at first rapid, then slow and irregular, pulse feeble, heart sounds distant and weak and cyanosis marked." He died an hour and a half after the accident. Johnstone and Miller do not state, however, whether or not the systemic effects were caused by inhalation or absorption through the skin. Because of its low vapor pressure, it can, however, be presumed that skin absorption was the major factor.

The MCA further notes "contaminated clothing should be removed at once. Speed in removing nitrobenzene from skin is of prime importance. A thorough shower, taken immediately with plenty of soap and water, is imperative." Also recommended is that "employees should take a shower and wash thoroughly at the end of each work day."

The NIOSH Toxic Substances List gives a rabbit skin penetration LDLo of 600 mg/kg.

Nitrobenzene has a vapor pressure which is much less than 1 mm Hg at 20 degrees C. It is 0.19% soluble in water and has a flash point of 190 degrees F. Its melting point is 41 degrees F.

Because of the rapidity with which it is absorbed through the skin and the possible extreme severity of its effects, this compound is assigned a classification of 1.
For the same reasons, and because it has a very low vapor pressure, statements 5a and 15 are concluded to be necessary for the liquid form of the substance.

Ingestion - Classification: 1

Output statement numbers: 1

Exceptions: None

According to Fairhall, "because of the wide range of use of substances containing nitrobenzene, poisoning with this agent is probably more common than is generally believed, although most cases are mild. In fatal cases, findings are marked cyanosis, congestion and, in moderate number, multiple subserious hemorrhages. Anemia is the most common feature, although fatigue, vertigo, headache, loss of appetite, vomiting, general weakness and numbness of the legs also occur."

Van Oettingen notes that in "more severe poisonings after ingestion of nitrobenzene, there is a burning sensation in the mouth and throat," followed by vomiting and nausea with frequent gastric pain and diarrhea with bloody stools. Headache of varying intensity is a common complaint, followed by progressive "depression of the central nervous system resulting in unconsciousness and coma."

Browning reports a case of accidental ingestion of a solution containing 3% nitrobenzene, "the victim complaining 30 min. to 1 hr. later of violent headache, with loss of consciousness and very dark cyanosis." The victim recovered on the seventh day following ingestion.

Chambers notes a case of fatal poisoning through ingestion of commercial spot-remover containing nitrobenzene in a 20-year-old male. "There was deep cyanosis of the entire body, with twitchings of both arms and muscles of the face, probably due to cerebral anoxia." Examination of stomach content, liver, brain, urine and kidney, showed nitrobenze to be present.

Patty says that intubation of nitrobenzene to dogs at 200 mg/kg regularly resulted in methemoglobin production, while Browning reported an LD20 of 0.64 g/kg as a 10% suspension in rats resulted in methemoglobin production. Gleason gives a mean lethal dose by mouth of 1 - 5 gms for humans.

Thienes and Haley give the fatal human dose as being 1 ml. Sax considers the chronic systemic effects of ingestion to be of high toxic hazard. The MCA states that "food should never be stored or eaten near nitrobenzene nor be in the proximity of nitrobenzene handling operations."

The overall toxicity of this substance clearly indicates that a classification of 1 is 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)

Manufacturing Chemists' Association, Chemical Safety Data Sheet, SD-21 (MCA)

E. I. duPont de Nemours and Co., "duPont Nitrobenzene" (duP)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 13, p. 834 (K-O)

Sources of data items used:

I. A. 1. Synonyms: NFPA-325M
2. Formula: NFPA-49, duP
3. Molecular weight: duP

B. 1. Boiling point: NFPA-325M, MCA, duP
2. Specific gravity: NFPA-325M, MCA
3. Vapor density: NFPA-325M
4. Melting point: duP
5. Vapor pressure: duP
6. Solubility in water: duP
7. Evaporation rate: Not applicable
8. Appearance and odor: NFPA-49, MCA

II. A. 1. Flash point: NFPA-325M, duP, MCA
2. Autoignition temperature: NFPA-325M, MCA
3. Flammable limits: NFPA-325M, MCA
4. Extinguishing media: NFPA-325M, NFPA-49, MCA
5. Special fire fighting procedures: NFPA-49
6. Unusual fire and explosion hazards: duP

B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: NFPA-491M, MCA
3. Hazardous decomposition products: ADL
4. Special precautions: ADL

III. A. Steps if released or spilled: NFPA-49, ADL

C. Waste disposal method: MCA, ADL

V. Miscellaneous precautions: NFPA-49, ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Browning, E., "Toxicity and Metabolism of Industrial Solvents," Elsevier Publishing Co., 1965 (Browning)

Doolittle, A. K., "The Toxicology of Solvents and Plasticizers," John Wiley and Sons, Inc., 1954 (Doolittle)

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

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

"Merck Index of Chemicals and Drugs," Merck and Co., Inc., Rahway, N. J., 8th edition, 1968 (Merck)

"Nitrobenzene," Hazard Process Index, Hazard Entry No. 139, Contract No. HSM-99-73-62, National Institute of Occupational Safety and Health (HPI)

"Nitrobenzene," Manual Sheet SD-21, Manufacturing Chemists' Association (MCA)

"Nitrobenzene," Material Safety Data Sheet, Cyanamid, April 18, 1972 (Cyanamid)
Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)
Poucher, W. A., "Perfumes, Cosmetics, and Soaps," Volume One., 5th edition, Van Nostrand, New York, 1941 (Poucher)
Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)
Stanford Research Institute, "Chemical Origins and Markets," Menlo Park, 1967 (Chem Origins)

References for Specific Use/Exposure

1. ILO, HPI
2. K-O, Chem Origins
3. HPI, SRI, K-O
4. Chem Origins, Doolittle
5. Chem Origins
6. K-O, Chem Origins
7. Chem Origins
8. K-O, Browning
9. K-O
10. Poucher, Browning, Patty
11. Doolittle, Chem Origins

References for Specific Control Methods

MCA, Cyanamid and ILO were the reference used in all the Specific Control Methods.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for NITROBENZENE

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Nitrobenzene

D. O. L. STANDARD: 1 ppm

WARNING PROPERTIES:

Odor Threshold: Both Stern and Staub report that the odor threshold of nitrobenzene is 1.9 ppm.

Eye Irritation Level: Browning states that nitrobenzene causes "only slight transient (eye) irritation." Grant states that "the most reliably established ocular effects are secondary to discoloration of the blood from methemoglobinemia, and consist of brown discoloration of the vessels of the fundus and the conjunctiva." For the purpose of this standard, half-facepiece respirators will be allowed up to a concentration of 10 ppm (PF = 10).

Evaluation of Warning Properties: Since the odor threshold of nitrobenzene is within 2 times the permissible exposure limits, nitrobenzene is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 200 ppm

Basis for IDLH Value: This IDLH is based upon the statement in the Documentation of TLV's that "Henderson and Haggard reported that 200 ppm is the maximum concentration that can be inhaled for one hour without serious disturbance . . ." The AIHA Hygienic Guides report similar information.

Other Toxicological Information: According to the AIHA Hygienic Guides, the severity of the health hazard of nitrobenzene is "high, for both acu and chronic exposures. Absorption by any route, including the skin, may lead to severe toxicity of death. Nitrobenzene may affect: a) the nervous system, giving rise to fatigue, veritgo, headache, vomiting, and general weakness, and signs of central nervous system involvement, such as altered pulse and respiration and skin temperature changes; b) the blood, producing methemoglobinemia and lowered red cell count; c) the spleen and liver, with jaundice a possibility." Concerning the short exposure tolerance to nitrobenzene, the AIHA Hygienic Guides state that "200 ppm may be inhaled for one hour without serious disturbance; slight symptoms may appear after a few hours exposure to 40-80 ppm." The Guides also state that nitrobenzene "may be almost immediately fatal if significant areas of the body are in contact with liquid or clothing saturated with liquid. Inhalation of massive concentrations may likewise prove rapidly fatal."

Patty points out that "nitrobenzene is a powerful methemoglobin former; in this respect probably more potent than aniline per unit of weight or vapor concentration."

Spector gives a mouse skin absorption MLD of 480 mg of nitrobenzene/kg.

The Documentation of TLV's states that "the TLV of 1 ppm should be low enough to prevent significant blood changes and even mild symptom of intoxication."

LFL AT 200 F: 18,000 ppm

VAPOR PRESSURE AT 20 C: 0.2 mm Hg (extrapolated)

SATURATED CONCENTRATION AT 20 C: Approximately 263 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for NITROBENZENE

USE/EXPOSURE AND CONTROL DOCUMENT
NITROBENZENE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during synthesis and handling of substance	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
2.	Inhalation of vapor and skin contact with liquid during production of intermediates (including aniline, benzidine, n-dinitrobenzene, m-, p- and o-nitrochlorobenzene, metanilic acid) during synthesis of dyes (including nigrosine, magenta, induline, and quinoline)	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
3.	Inhalation of vapor and skin contact with liquid during solvent refining of lubricating oils	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
4.	Inhalation of vapor and skin contact with liquid during production of intermediates in synthesis of rubber chemicals (including aniline, benzidine, p-nitrochlorobenzene)	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
5.	Inhalation of vapor and skin contact with liquid during production of intermediates (including aniline and p-nitrochlorobenzene) in synthesis of photographic chemicals	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
6.	Inhalation of vapor and skin contact with liquid during production of intermediates in explosives synthesis (including dinitrobenzene) and synthesis	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)

	and handling of liquid propellants		
7.	Inhalation of vapor and skin contact with liquid during production of intermediates (including aniline and p-nitrochlorobenzene) in synthesis of pharmaceuticals	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
8.	Inhalation of vapor and skin contact with liquid during use as a solvent in manufacture and handling of specialized surface coatings (including dipping stains for plastics)	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
9.	Inhalation of vapor and skin contact with liquid during use as a solvent in organic synthesis	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
10.	Inhalation of vapor and skin contact with liquid during use as a perfume in manufacture of toilet and household soaps	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)
11.	Inhalation of vapor and skin contact with liquid during production of intermediates in synthesis of insecticides and germicides	A,D	Process enclosure; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, goggles)

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