

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** NAPHTHALENE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for NAPHTHALENE

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 NAPHTHALENE.

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 naphthalene not in excess of 10 parts per million (ppm) (50 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 naphthalene averaged over an eight-hour work shift.

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

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

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

(ii) Any measurements of naphthalene taken;

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

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

(3) If the employer determines that any employee may be exposed to naphthalene above the permissible exposure, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to naphthalene above the action level, the employer shall:

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

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

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

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

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to naphthalene below the action level, the employer may terminate measurement for the employee.

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(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	± 25%
At or below permissible exposure and above the action level	± 35%
At or below the action level	± 50%

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

(2) Employee exposures to airborne concentrations of naphthalene shall be controlled to at or below the permissible exposure by engineering and work practice controls.

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. (i) When local exhaust is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity or static pressure, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of naphthalene.

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

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

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

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

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

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Particulate and Vapor Concentration	
500 ppm or less	<p>A chemical cartridge respirator with a full facepiece organic vapor cartridge(s) and dust filter.</p> <p>-----</p> <p>A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust filter.</p> <p>-----</p> <p>Any supplied-air respirator with a full facepiece, helmet or hood.</p> <p>-----</p> <p>Any self-contained breathing apparatus with a full facepiece.</p>
Greater than 500 ppm or entry and escape from unknown concentrations	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p> <p>-----</p> <p>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.</p>
Fire Fighting	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p>
Escape	<p>Any gas mask providing protection against organic vapors and particulates.</p> <p>-----</p> <p>Any escape self-contained breathing apparatus.</p>

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

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

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

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

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

(5) Where a fan is located in ductwork and where naphthalene is present in the ductwork in concentrations greater than 2300 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.

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

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

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with naphthalene or liquids containing naphthalene. 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 naphthalene change into uncontaminated clothing before leaving the work premises.

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

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

(5) Employers shall provide and ensure that employees use safety goggles which comply with § 1910.133(a)(2)-(a)(6) where naphthalene or liquids containing naphthalene may contact the eyes.

(g) Spills and disposal. (1) In the event that naphthalene 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 naphthalene promptly wash or shower with soap or mild detergent and water to remove any naphthalene from the skin.

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(2) Employers shall ensure that employees do not eat or smoke in areas where solid naphthalene is handled, processed or stored.

(3) Employers shall ensure that employees who handle naphthalene or liquids containing naphthalene 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 naphthalene 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 naphthalene above the action level without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with naphthalene or liquids containing naphthalene, or employees who work where naphthalene presents a fire or explosion hazard, shall annually:

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

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

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

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

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

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

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

(iii) Urinalysis to include specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

(3) Periodic medical examination. The employer shall make available to each employee exposed to airborne concentrations of naphthalene above the action level, without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with naphthalene or liquids containing naphthalene, 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 eyes, blood, liver, kidneys and skin;

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

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(iii) Urinalysis to include specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

(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 for the employee if the employee informs the employer of any of the signs or symptoms of exposure to naphthalene which are listed in Appendix A which the employee suspects are caused by exposure to naphthalene.

(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 naphthalene;

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

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure level; and

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

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

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

(A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to naphthalene;

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

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

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

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

(9) Results of tests. Where a preplacement or periodic medical examination is required by paragraphs (j)(2) or (j)(3) of this section,

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following such examination the employer shall obtain from the examining physician for inclusion in the employee's medical record:

(i) A recording of the results of the urinalysis and 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 naphthalene in such a way as would put the employee at increased risk of material impairment of his health from such exposure. The employer shall base this decision on any information available including the physician's written opinion.

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

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

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

(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 naphthalene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to naphthalene 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:

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(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 naphthalene;

(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 naphthalene.

(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 naphthalene which is conducted pursuant to this section.

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

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for naphthalene is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent

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the information supplements this regulation for naphthalene, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR NAPHTHALENE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Naphthalene
- B. Permissible Exposure: 10 parts of naphthalene per million parts of air (ppm) (50 milligrams of naphthalene per cubic meter of air (mg/M3)) averaged over an eight-hour work shift.
- C. Appearance and Odor: Colorless to brown solid with the odor of mothballs

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Naphthalene can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it. It may enter your body through your skin.
- B. Effects of Overexposure:
 - 1. Short-term Exposure: Inhalation or ingestion of naphthalene may cause abdominal cramps, nausea, vomiting, diarrhea, headache, tiredness, confusion, painful urination and bloody or dark urine. Swallowing large amounts may cause convulsions or coma. Inhalation, ingestion and possibly skin absorption of naphthalene may cause destruction of red blood cells with anemia, fever, yellow jaundice, bloody urine, kidney and liver damage. Naphthalene, on contact with the eyes, has produced irritation. Naphthalene, in contact with the skin, has produced skin irritation.
 - 2. Long-term Exposure: Repeated skin exposure to naphthalene may cause an allergic skin rash. Repeated exposure may cause cataracts.
 - 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 naphthalene.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If naphthalene or liquids containing naphthalene get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If molten naphthalene gets on your skin, flush the skin immediately with large amounts of water. Get

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medical attention immediately. If naphthalene or liquids containing naphthalene get on your skin, promptly wash the contaminated skin using soap or mild detergent and water. If naphthalene or liquids containing naphthalene penetrate your clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation is present after washing, get medical attention.

- C. Breathing: If you or any other person breathes in large amounts of naphthalene move the exposed person to fresh air at once.
- D. Swallowing: When naphthalene has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to naphthalene. 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 naphthalene while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with naphthalene or liquids containing naphthalene. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles where liquids containing naphthalene may contact your eyes. You must wear dust-resistant safety goggles where naphthalene may contact your eyes. Vapor tight goggles are recommended where naphthalene vapors may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Naphthalene is a combustible solid. Its vapors can form explosive mixtures with air at elevated temperatures.
- B. Naphthalene must be stored in tightly closed containers in a cool, well ventilated area away from strong oxidizers.
- C. Sources of ignition such as smoking and open flames are prohibited wherever naphthalene is handled, used or stored in

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a manner that could create a potential fire or explosion hazard.

- D. If your work clothing may have become contaminated with solid naphthalene, you must change into uncontaminated clothing before leaving the work premises.
- E. You must promptly remove any non-impervious clothing that becomes contaminated with naphthalene and this clothing must not be reworn until the naphthalene is removed from the clothing.
- F. If your skin becomes contaminated with naphthalene, you must promptly wash or shower with soap or mild detergent and water to remove any naphthalene from your skin.
- G. You must not eat or smoke in areas where naphthalene is handled, processed or stored.
- H. If you handle naphthalene or liquids containing naphthalene, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or with toilet facilities.
- I. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.
- J. Ask your supervisor where naphthalene 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 naphthalene. In addition, your employer must instruct you in the safe use of naphthalene, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to naphthalene. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of five years following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
- D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

NOTE: The information contained in the following appendix for naphthalene is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR NAPHTHALENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: White tar; naphthalin
2. Formula: $C_{10}H_8$
3. Molecular weight: 128.2

B. Physical Data

1. Boiling point (760 mm Hg): 218 C (424 F)
2. Specific gravity (water = 1): 1.14
3. Vapor density (air = 1 at boiling point of naphthalene): 4.4
4. Melting point: 74 - 80 C (165 - 176 F)
5. Vapor pressure at 20 C (68 F): 0.05 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.003
7. Evaporation rate (butyl acetate = 1): Much less than 1
8. Appearance and odor: Colorless to brown solid with the odor of mothballs

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 79 C (174 F) (closed cup)
2. Autoignition temperature: 526 C (979 F)
3. Flammable limits in air, % by volume: Lower: 0.9; Upper: 5.9
4. Extinguishing media: Carbon dioxide, dry chemical, foam
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: Naphthalene is a combustible solid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where naphthalene is used, handled or stored in a manner that could create a potential fire or explosion hazard.
7. 2300 ppm, approximately one-fourth of the lower flammable limit, is one situation in which naphthalene is considered to be a potential fire and explosion hazard.

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8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for naphthalene shall be Class I, Group D.

B. Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as dense acrid smoke, carbon dioxide, and carbon monoxide) may be released in a fire involving naphthalene.
4. Special precautions: Melted naphthalene will attack some forms of plastics, rubber and coatings.

III. SPILL AND DISPOSAL PROCEDURES

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

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber.

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

- C. Waste disposal methods: Naphthalene may be disposed of:

1. By making packages of naphthalene in paper or other flammable material and burning in a suitable combustion chamber.
2. By dissolving naphthalene in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Several short-time interval samples (up to 30-minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by collection of the particulates and vapors with a high efficiency membrane filter followed by an adsorption tube with subsequent chemical analysis of both the filter and adsorption tube. Detector tubes certified by NIOSH under 42 CFR part 84 or other direct-reading devices calibrated to measure naphthalene may be used. The method of measurement must determine the concentration of naphthalene to plus or minus 35%.

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- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described above. More than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Samples should be collected as described in paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of naphthalene to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set T" (Order number XXXXXXXXXX).
- D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store naphthalene in tightly closed containers in a cool, well ventilated area.
- B. Vapor tight goggles are recommended for use by employees where they may have eye contact with naphthalene vapors.
- C. Employers should advise employees of all areas and operations where their exposure to naphthalene could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to naphthalene is likely to occur are: During its production and its use as a chemical intermediate.

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

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

- Inhalation.

II. TOXICOLOGY

Naphthalene vapor causes hemolysis and eye irritation; it may cause cataracts. Severe intoxication from ingestion of the solid results in

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characteristic manifestations of marked intravascular hemolysis and its consequences, including potentially fatal hyperkalemia. Initial symptoms include eye irritation, headache, confusion, excitement, malaise, profuse sweating, nausea, vomiting, abdominal pain, and irritation of the bladder; there may be progression to jaundice, hematuria, hemoglobinuria, renal tubular blockade, and acute renal shutdown. Hematologic features include red cell fragmentation, icterus, severe anemia with nucleated red cells, leucocytosis, and dramatic decreases in hemoglobin, hematocrit, and red cell count; sometimes there is formation of Heinz bodies and methemoglobin. Individuals with a deficiency of glucose-6-phosphate dehydrogenase in erythrocytes may be more susceptible to hemolysis by naphthalene. Cataracts and ocular irritation have been produced experimentally in animals and have been described in humans; of 21 workers exposed to high concentrations of fume or vapor, for 5 years, 8 had peripheral lens opacities; in other studies no abnormalities of the eyes have been detected in workers exposed to naphthalene for several years. The vapor causes eye irritation at 15 ppm; eye contact with the solid may result in conjunctivitis, superficial injury to the cornea, chorioretinitis, scotoma, and diminished visual acuity. Naphthalene on the skin may cause hypersensitivity dermatitis; chronic dermatitis is rare.

III. SIGNS AND SYMPTOMS

Eye irritation; headache, confusion, excitement, malaise; nausea, vomiting, abdominal pain, irritation of the bladder; profuse sweating; jaundice; hematuria, hemoglobinuria, renal shutdown; hypersensitivity dermatitis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Promptly flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Consideration should be given to hospitalization for symptomatic and supportive treatment as with other types of acute hemolytic anemia.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of naphthalene are caused by its irritant properties. Hemolysis is a recognized complication from ingestion.

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Increased susceptibility to the hemolytic effects may occur in persons with a deficiency of glucose-6-phosphate dehydrogenase in erythrocytes. It is suspected to be a cause of cataracts following prolonged high-level exposure. It is important that the physician become familiar with plant operating conditions in which exposure to naphthalene 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 naphthalene:

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a deficiency of glucose-6-phosphate dehydrogenase in erythrocytes may be at increased risk from exposure. Examination of the eyes, blood, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.
2. A complete blood count -- Naphthalene has been shown to cause red blood cell hemolysis. 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.
3. Urinalysis -- Since kidney damage may also occur from exposure to naphthalene, a urinalysis shall be obtained to include at a minimum specific gravity, albumin, glucose and a microscopic on centrifuged sediment.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Naphthalene," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 177-178.
2. Hygienic Guide Series: "Naphthalene" American Industrial Hygiene Association Journal, 28:493-496, 1967.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1237-1239.

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4. Gleason, M.N., et al: Clinical Toxicology of Commercial Products, (3d ed.), Williams and Wilkins Company, Baltimore, 1969, Section III, pp. 165-168.

5. Zinkham, W.H. and B. Childs: "A Defect of Glutathione Metabolism in Erythrocytes from Patients with a Naphthalene-Induced Hemolytic Anemia," Pediatrics, 22:461-471, 1958.

6. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles C. Thomas, Springfield, Illinois, 1974, pp. 733-739.

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REFERENCES AND SOURCES
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- (e) Fire and Safety
(1) Electrical - Classification based on "Fire Hazard Classification of Chemical Vapors Relative to Explosion-proof Electrical Equipment," H. Carhart et al., National Academy of Sciences, 1973, report to U.S. Coast Guard, report no. CG-D-92-74, p. 17.
- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye;" Union Carbide Corp., "Toxicology Studies;" American Petroleum Institute, "API Toxicology Reviews;" International Labour Office, "Encyclopedia of Occupational Health and Safety"
Skin: Stecher, "The Merck Index," eighth edition; American Petroleum Institute, "API Toxicology Reviews;" Manufacturing Chemists' Association, Chemical Safety Data Sheets; Union Carbide Corporation, "Toxicology Studies;" Stolman, "Progress in Chemical Technology;" Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" International Labour Office, "Encyclopedia of Occupational Health and Safety"
Ingestion: American Petroleum Institute, "API Toxicology Reviews;" Manufacturing Chemists' Association, Chemical Safety Data Sheets; Patty, "Industrial Hygiene and Toxicology;" Gleason, "Clinical Toxicology of Commercial Products;" Spector "Handbook of Toxicology;" Union Carbide Corporation, "Toxicology Studies;" Stecher, "The Merck Index," eighth edition; Christensen, "NIOSH Toxic Substances List," 1974; Grant, "Toxicology of the Eye"

COMMENTS

Eye - Classification: 2 and 6
Output statement numbers: 10 and 12 combined
Exceptions: None

According to Grant, "external contact of naphthalene with the eyes is irritating but not injurious unless actual particles are allowed to remain in contact with the cornea. Experimentally when pure crystallized naphthalene was applied to rabbit eyes and allowed to remain for an unspecified period, local epithelial injury and slight turbidity of the underlying stroma have been observed, but in the course of two weeks the cornea cleared and healed completely."

Union Carbide reports that "flooding the rabbit eye with an excess of the chemical caused a reaction no more severe than moderate inflammation."

The API reports that "naphthalene will cause irritation when it comes in contact with the eye, but no serious eye injuries have been reported."

The ILO notes "eye contact with . . . condensed microcrystals may result in punctiform keratitis and even chorioretinitis."

Classifications of 2 and 6 are concluded to be most appropriate.

Skin - Classification: 2 and 6

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Output statement numbers: 2, 5b, 7a, 17g, 17i, 20a

Exceptions: None

Stecher reports "poisoning may occur by . . . skin absorption" and lists signs and symptoms as "nausea, vomiting, headache, diaphoresis, hematuria, hemolytic anemia, fever, hepatic necrosis, convulsions, and coma."

According to the API, "persons who are hypersensitive to naphthalene may get a variety of dermatoses from handling it. One patient had an intense generalized erythema and a weeping, crusted lesion of the scalp following handling of clothing freely sprinkled with naphthalene flakes. The skin lesions may closely resemble mycosis fungoides. Several women working with a mineral oil containing 1 to 1.5 per cent of naphthalene developed a moist dermatitis of the hands and forearms (and, in some cases, of the face, neck, abdomen and thighs). These conditions generally clear up rapidly upon removal of the patient from contact with naphthalene."

The MCA reports "dermatitis from prolonged or repeated handling of naphthalene, particularly the crude product, has been reported but it is rare."

Union Carbide reports that the substance single skin penetration is "estimated to have no skin penetration hazard" and "the undiluted chemical caused no reaction on the tender skin of the rabbit belly greater than a faint redness of short duration." However, it does indicate "dermatosis" developing in "hypersensitive persons."

Stolman says "an oily condition of the skin may facilitate absorption." Patty reports "no information is available concerning skin absorption."

Deichman and Gerarde report "fatal hemolytic anemia has been described in a newborn infant whose diapers had been contaminated with naphthalene mothballs."

The ILO notes "skin contact has been found to cause erythematoexudative dermatitis; however, such cases have been attributed to contact with crude naphthalene which still contained phenol which is the causitive (sic) agent of the foot dermatitis encountered amongst workers who discharge naphthalene crystallization trays."

Naphthalene has a melting point range of 165 - 176 degrees F, a flash point of 174 degrees F and a vapor pressure of 20 degrees C of 0.05 mm Hg. It is 0.003% soluble in water.

Classifications of 2 and 6 are concluded to be sufficient to prevent the cited effects.

Ingestion - Classification: 2 and 6

Output statement numbers: 19, 20a

Exceptions: None

According to the API, "no chronic toxic effects have been reported as a result of industrial exposure to naphthalene. The toxic manifestations observed after repeated oral administration are headache, mental depression, digestive disturbances, and nephritis. One case of acute lymphatic

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leukemia has been reported in which an attempt was made to establish a connection with the long-continued use of naphthalene as a vermifuge. The dog pathology which has been cited herein was used in defending this position, but the significance is open to question."

The MCA reports "rare poison cases in children have occurred due to eating mothballs of naphthalene. The compound is highly insoluble in the gastrointestinal tract and is usually excreted unchanged."

According to Patty, "rabbits dosed with 1 g of naphthalene per kilogram of body weight daily, developed changes in the lens after 3 doses and definite opacity of the lens after 20 doses. A case of a human cataract has been reported which may be the counterpart of the cataracts produced experimentally in rabbits."

Gleason says the "mean lethal dose in nonsensitive adults may lie between 5 and 15 gm, but no convincing evidence can be cited in support of this estimate. Six grams have been survived, but 2 gm over a 2-day period killed a 6-year-old child."

According to Spector, the material is "toxic for mammals only in comparatively large doses. Two to three grams reported to constitute a fatal dose for man. More toxic, orally, in the presence of oil."

Union Carbide rates the single oral dose in rats as a "moderate hazard," and gives the LD50 as 9.43 gm per kg body weight.

Stecher states "poisoning may occur by ingestion" and list signs and symptoms as "nausea, vomiting, headache, diaphoresis, hematuria, hemolytic anemia, fever, hepatic necrosis, convulsions, and coma."

Christensen lists the oral rat LD50 as 1780 mg/kg.

Grant gives a detailed account of the effects of naphthalene poisoning on the eye. The possibility is indicated that repeated ingestion of small quantities may lead to cataract formation, though "injury of human eyes from systemic poisoning with naphthalene is uncertain, and rather scantily documented."

It is concluded that classifications of 2 and 6 are sufficient to prevent the cited effects.

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-58 (MCA)

K.N. Palmer, "Dust Explosions and Fires," Chapman and Hall, London, 1973 (Palmer)

Koppers Co., Inc., Material Safety Data Sheet (Kopp)

Sun Oil Co., Material Safety Data Sheet (Sun)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 13, p. 670 (K-O)

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Sources of data items used:

- I. A. 1. Synonyms: NFPA-325M, Kopp
- 2. Formula: NFPA-325M
- 3. Molecular weight: ADL
- B. 1. Boiling point: NFPA-325M, MCA, Kopp
- 2. Specific gravity: MCA, Kopp
- 3. Vapor density: NFPA-325M, MCA, Kopp
- 4. Melting point: MCA
- 5. Vapor pressure: K-O
- 6. Solubility in water: Sun
- 7. Evaporation rate: Kopp
- 8. Appearance and odor: NFPA-49, MCA
- II. A. 1. Flash point: NFPA-325M, MCA, Kopp
- 2. Autoignition temperature: NFPA-325M, Sun
- 3. Flammable limits: NFPA-325M, MCA, Kopp
- 4. Extinguishing media: NFPA-49, MCA, Kopp
- 5. Special fire fighting procedures: NFPA-49, Kopp, ADL
- 6. Unusual fire and explosion hazards: NFPA-49, Palmer, Sun
- B. 1. Conditions contributing to instability: ADL
- 2. Incompatibilities: NFPA-49
- 3. Hazardous decomposition products: ADL
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: Sun, MCA
- C. Waste disposal method: Sun, MCA
- V. Miscellaneous precautions: MCA

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- API Toxicological Review, "Naphthalene," American Petroleum Institute, 2nd edition, 1959 (API)
- Baskin, A. D. - editor, "Handling Guide for Potentially Hazardous Commodities," Railway Systems and Management Association, Chicago, 1972 (Baskin)
- Considine, D. M., "Chemical and Process Technology Encyclopedia," McGraw - Hill, 1974 (Considine)
- Faith, W. L., Keyes, D. P. and Clark, R. L., "Industrial Chemicals," Wiley, 1965 (Faith)
- International Labour Office, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience, 2nd edition, vol. 7, 1965; vol. 13, 1967 (K-O)
- "Naphthalene," American Conference of Governmental Industrial Hygienists, Hygienic Guide Series, October 1967 (Guide)
- "Naphthalene," Dow Chemical Co., Material Safety Data Sheet, Sept 19, 1972 (Dow MSDS)
- "Naphthalene," Hazard Process Index, Hazard Entry No. 131, NIOSH-HSM-99-73-62 (HPI)
- "Naphthalene," Koppers Co., Inc., Material Safety Data Sheet, May 1969 (Koppers MSDS)
- "Naphthalene," Manufacturing Chemists' Association, Chemical Safety Data Sheet, SD-58, 1956 (MCA)
- "Naphthalene," National Safety Council, Data Sheet 370, 1970 (NSC)
- National Fire Codes, volume 3, "Combustible Solids, Dusts and Explosives," NFPA-49, National Fire Protection Assoc., Boston, 1973 (NFPA-49)

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Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)

References for Specific Use/Exposure

1. SRI, API, K-O, ILO
2. HPI, Guide, API, ILO, K-O, SRI
3. Faith, ILO, HPI, API, MCA, K-O, SRI

HPI, SRI, API, K-O, ILO, Considine and NSC were the references used in numbers 4 - 10.

References for Specific Control Methods

NSC, NFPA-49, Baskin, API, Sun MSDS, ILO, Guide, MCA, Dow MSDS and Koppers MSDS were the references used in all the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Naphthalene

D. O. L. STANDARD: 10 ppm

WARNING PROPERTIES:

Odor Threshold: The AIHA Hygienic Guides report that the odor threshold of naphthalene is "at least as low as 0.3 ppm."

Eye Irritation Level: The Hygienic Guides state that "naphthalene vapor is reported to cause eye irritation at 15 ppm or above in air."

For the purposes of this standard, only full facemask respirators are permitted.

Evaluation of Warning Properties: Through its odor and irritant effects, naphthalene can be detected at or below the permissible exposure limit. Naphthalene, therefore, is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 500 ppm

Basis for IDLH: There are no useful acute inhalation toxicity data available upon which to base the IDLH for naphthalene. The chosen IDLH, therefore, has been estimated from the probable lethal oral dose for an adult of 5 to 15 grams given in the AIHA Hygienic Guides.

Other Toxicological Information: The AIHA Hygienic Guides state that "naphthalene is readily absorbed when inhaled and may cause eye irritation, headache, nausea and profuse perspiration. Vomiting, hematuria, edema and rarely optic neuritis have been reported in individuals exposed to high atmospheric concentrations. In this country no chronic effects have been reported as a result of industrial exposure to naphthalene." The Hygienic Guides note that under ordinary conditions, naphthalene does not have a great enough vapor pressure to result in an IDLH concentration. According to the Guides, however, the probable lethal oral dose for an adult is believed to range from 5 to 15 gm. "The ingestion of an overdose of naphthalene causes nausea, vomiting, abdominal pain, irritation of the bladder, and brown or black coloration of the urine."

The Documentation of TLV's also reports that "according to Flury and Zernik and Patty, the inhalation of naphthalene vapor may cause headache, loss of appetite, and nausea. Optical neuritis and injuries to the cornea and, in addition, kidney damage have also been reported. Ghetti and Mariani reported opacities of the lens in 8 of 21 workers who had been exposed to naphthalene for about five years. Ingestion of naphthalene in relatively large amounts has reportedly caused severe hemolytic anemia and hemoglobinuria.

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A hypersusceptibility, probably genetically based, is recognized.

"Patty suggested 25 ppm as a tentative limit for naphthalene vapor in air. He noted that this corresponds to a saturation pressure of about 25% at 25 degrees C. This value has been used at the Los Alamos Laboratories, according to Hyatt and Milligan. Robbins, however, reported that concentrations in excess of about 15 ppm resulted in noticeable irritation of the eyes. Soviet authorities recommended a limit of 4 ppm.

"Gerarde also suggested 25 ppm as a tentative limit, noting that it represents 25% of the concentration of naphthalene vapor in air saturated at 25 degrees C.

"In view of the fact that irritation is experienced at 15 ppm and that continued exposure may result in fairly serious eye effects, a limit lower than 25 ppm would seem in order. The value of 10 ppm is recommended as a threshold limit to prevent ocular effects, but possibly not blood changes in hypersusceptibles."

LFL: 9000 ppm

VAPOR PRESSURE AT 20 C: 0.05 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 65.8 ppm or 344 mg/M3

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Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor or dust and skin contact with solid or liquid during fabrication and mixing for insecticidal use as flakes, powder, balls or cakes	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice
2. Inhalation of vapor or dust and skin contact with solid during use as fumigant (moth repellent and insecticide)	A,B	General dilution ventilation; personal protective equipment (gloves); good personal hygiene practice
3. Inhalation of vapor or dust and skin contact with solid or liquid during manufacture, distribution, and maintenance of equipment and storage containers	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure
4. Inhalation of vapor or dust and skin contact with solid or liquid during use in manufacture of phthalic anhydride (used for production of pharmaceuticals, insecticides, resins, dyes and plasticizers)	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure
5. Inhalation of dust or vapor and skin contact with solid or liquid during use in manufacture of tetrahydronaphthalene (intermediate in production of carbaryl insecticide) and decahydronaphthalene (solvent for resins and coatings)	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure
6. Inhalation of dust or	A,B	Local exhaust ventilation;

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- vapor and skin contact with solid or liquid during use in manufacture of 2-naphthol (intermediate in production of dyes, pigments, and rubber chemicals)
7. Inhalation of dust or vapor and skin contact with solid or liquid during use in manufacture of naphthalenesulfonic acids (production of dyes, rubber antioxidants, pharmaceuticals, and tanning agents) and alkylnaphthalenesulfonic acids (production of surface active agents and textile treating assistants) A,B Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure
8. Inhalation of dust or vapor and skin contact with solid or liquid during use in manufacture of chloronaphthalenes (production of solvents, waxes, plasticizers; use as cable coatings and in storage batteries) A,B Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure
9. Inhalation of dust or vapor and skin contact with solid or liquid during use in manufacture of nitronaphthalenes (production of dyes, rodenticides, rubber antioxidants) A,B Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure
10. Inhalation of dust or vapor and skin contact with solid or liquid during use in manufacture of alkylnaphthalenes (production of surface active agents, textile spinning lubricants) A,B Local exhaust ventilation; general dilution ventilation; personal protective equipment (respiratory protective devices, protective clothing, gloves, goggles, face shield, aprons, shoes); good personal hygiene practice; process enclosure

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