NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** HEPTANE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for HEPTANE

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 HEPTANE.

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 - "Permissible Exposure" means inhalation of heptane in concentrations not in excess of 500 parts per million (ppm) (2,000 milligrams per cubic meter, mg/cu.m.) averaged over an eight hour work shift, as stated in section 1910.93, Table G-1.

(2) ACTION LEVEL - "Action Level" means one half (1/2) of the permissible exposure for heptane.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which heptane is present shall:

(1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices A, B and C, at the workplace. This material shall be made readily available to affected employees; and

(2) PRESENCE OF HEPTANE - Inform affected employees of the quantity, location, and manner of use or storage of heptane.

(c) EXPOSURE MEASUREMENT

(1) INITIAL DETERMINATION - Each employer who has a place of employment in which heptane is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of heptane 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 heptane. A written determination shall be made and it shall contain at least the following information:

(i) Any information, observations, or calculations which would indicate employee exposure to heptane;

(ii) Any measurements of airborne concentrations of heptane taken;

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

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(2) INITIAL EXPOSURE MEASUREMENT - If the employer determines that any employee may be exposed to airborne concentrations of heptane at or above the action level, the exposure of the employee believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum exposure of the employee.

(3) IDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of heptane 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.

(4) EXPOSURE ABOVE THE ACTION LEVEL - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of heptane 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.

(5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne

concentrations of heptane above the permissible exposure, the employer shall:

(i) Inform the employee of the exposure as required by paragraph (N)(1) of this section; and

(ii) Measure the exposure of the employee at least monthly; and

(iii) Institute control measures as required by paragraph (E) of this section.

(6) TERMINATION OF EXPOSURE MEASUREMENT - If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to airborne concentrations of heptane below the action level, the employer may terminate measurement for the employee. For purposes of this subparagraph, use of respirators shall not constitute reduction of employee exposure below the action level.

(d) METHODS OF MEASUREMENT - 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 (Appendix B (iv)). The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1 below.

Table 1

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

(e) Methods of Compliance

(1) Engineering controls - No employee shall be exposed to heptane above the permissible limit as defined in paragraph (a)(1) of this section. Engineering and work practice controls shall be used to reduce exposure to heptane to at or below the permissible exposure.

(i) When mechanical ventilation is used to control exposure, measurements which demonstrate system efficiency (for example: air velocity, static pressure, or air volume) shall be made at least every three months. Measurements of system efficiency shall also be made within five work days of any change in production, process or control which might result in a reduction in control.

(ii) Where a fan is located in duct work and where heptane is present in concentrations greater than 2625 ppm, one fourth of the lower flammable limit, the fan rotating element shall consist of, or be lined with, non-sparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open surface tank ventilation for the purposes of section 1910.94 (d), operations involving heptane shall be classified as B-1 at 70 F.

(2) Respirators

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

a. During the time period necessary to install engineering controls; or

b. In work situations in which engineering controls are technically not feasible; or

c. In work situations in which feasible engineering and work practice controls are insufficient to reduce employees exposure to at or below the permissible exposure. Where technically feasible engineering and work practice controls are not sufficient to reduce exposure to at or below permissible exposure, they shall be used to reduce exposure to the lowest level feasible; or

d. For operations not exceeding 40 hours per year; or

e. In emergencies.

(ii) Respirators shall be jointly approved by the mining enforcement and safety administration (formerly Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(iii) Employers shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

(iv) Employers shall institute a respiratory protection program in accordance with sections 1910.134(b), (d), (e), and (f).

TABLE 2. RESPIRATORY PROTECTION FOR HEPTANE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
Equal to or less than 1000 ppm	Any chemical cartridge respirator with an organic vapor cartridge(s). A gas mask with chin-style or front- or back-mounted organic vapor canister.
Equal to or less than 5000 ppm	Any supplied air respirator. Any self-contained breating apparatus. Any self-contained breathing apparatus with a full facepiece.
Greater than 5000 ppm or escape and entry from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pres 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 air supply 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-pres mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

(f) Fire and Safety

Employers shall familiarize themselves with the information contained in the Substance Technical Guidelines for heptane which is contained in Appendix B in order to ensure the safe handling and use of heptane.

(1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of heptane shall be Class I Group D.

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, heptane is classified as a Class B fire hazard.

(3) Powered industrial trucks - For the purposes of compliance with section 1910.178, locations classified as hazardous locations due to the presence of heptane shall be Class I Group D.

(4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid heptane is classified as a Class IB flammable liquid. Spray finishing operations shall be performed in accordance with sections 1910.107 and 1910.94 (c). Dip tank operations shall be performed in accordance with sections 1910.108 and 1910.94 (d).

(5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where heptane is handled, used or stored in a manner so as to create a potential fire or explosion hazard.

(6) Storage - Heptane shall be stored so as not to come in contact with strong oxidizers.

(g) Personal Protective Equipment

(1) Skin Contact

(i) Employers shall provide, and require employees to use, impervious clothing, gloves, face shields (8-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact to liquid heptane. Face shields shall comply with section 1910.133(a)(6).

(ii) Employers shall ensure that clothing which becomes wet with liquid heptane be removed immediately and not reworn until the heptane is removed from the clothing.

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

(2) Eye Contact

(i) Employers shall provide, and require employees to use, splash-proof safety goggles (cup-cover type dust and splash safety goggles), which comply with section 1910.133 (a)(6), where eye contact to liquid heptane may occur.

(h) Spills

(1) Spills of heptane shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.

(2) Liquid heptane may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(i) Sanitation

(1) Employers shall ensure that employees whose skin becomes wet with liquid heptane promptly wash or shower to remove any heptane from the skin.

(j) Training and Information - Each employer who has employees exposed to heptane in excess of the action level, or employees who may have skin or eye contact with liquid heptane, or employees who work where accidental release, spill, fire, or explosion of heptane may occur, shall annually:

(1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for heptane, which is contained in Appendix A; and

(2) Medical -

(I) Advise employees as to the signs and symptoms of exposure to heptane.

(II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to heptane which are listed in Appendix A.

(III) Instruct the employees to inform the employer if they develop any of the medical conditions listed in (k)(2) of this section; and

(3) Procedures -

(I) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to heptane.

(II) The procedures required by (j)(1), (2), and (3)(I) shall be provided to employees at the expense of the employer during the employee's normal working hours.

(k) Medical Surveillance

(1) The employer shall provide medical procedures as required by paragraph (k). These procedures shall be provided at no cost to the employee.

(2) Preplacement Questionnaire - The employer shall obtain from each employee who will be exposed to airborne concentrations of heptane at or above the action level, a written statement as to whether such employee has a history of any of the following:

(i) Chronic lung disease
(ii) Skin disease
(iii) Liver disease
(iv) Kidney disease

(3) Preplacement Medical Examination - The employer shall provide a medical examination for an employee if the employee provides a history of any of the conditions named in paragraph (k)(2).

(4) Results of Preplacement Examination - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(3).

(5) Periodic Medical Examinations - The employer shall provide a medical examination for an employee if the employee advises the employer of the development of:

(i) Any of the medical conditions listed in (k)(2).

(ii) Signs and symptoms listed in Appendix A which the employee suspects may be caused by exposure to heptane.

(6) Results of Periodic Examinations - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(5).

(7) Exclusion or Removal from Exposure - No employee shall continue to be exposed to heptane if such exposure could place the employee at increased risk of material impairment of his health.

(8) Emergency Procedures - The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to heptane.

(9) Informing the Physician - The employer shall provide to the examining physician the following information:

(i) A copy of this section with its Appendices A, B, and C;

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

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

(iv) The results of any employee's exposure measurement, if available;

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

(vi) Upon request of the physician, information from previous medical examination of the employee.

(10) 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 conditions which could be directly or indirectly aggravated by exposure to heptane or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.

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

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

(ii) The written opinion shall not reveal medical information unrelated to exposure to heptane.

(11) Refusal to be Medically Examined - 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 risks involved by refusing to be examined.

(l) Recordkeeping.

(1) Initial determination.
  (i) The employer shall keep an accurate record of all initial determinations required to be made pursuant to paragraph (c)(1) of this section.
  (ii) The record shall include the written determination and any supporting documentation as required in paragraph (c)(1) 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 heptane.
  (ii) This record shall include:
    (a) The date of measurement;
    (b) A reference to the subparagraph of this regulation which required the measurement, if any;
    (c) Operations involving exposure to heptane which are being monitored;
    (d) Sampling and analytical methods used and evidence of their accuracy;
    (e) Number, duration, and results of samples taken;
    (f) 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 a record of measurements demonstrating the effectiveness of such ventilation as required by paragraph (e)(1)(i) of this section.
  (ii) This record shall include:
    (a) Date of measurement;
    (b) Type of measurement taken;
    (c) Result of measurement.
  (iii) This record shall be maintained for at least one year.
(4) Training and information.
  (i) The employer shall keep an accurate record of all employee training and advice required by paragraph (j) of this section.
  (ii) The record shall include:
    (a) Date of training;
    (b) Name and Social Security number of employees trained;
    (c) Substance of training provided.
  (iii) This record shall be maintained until replaced by a more recent record.
(5) Medical records.
  (i) The employer shall keep an accurate medical record for each employee.
  (ii) The record shall include:
    (a) Physician's written opinion;
    (b) Preplacement questionnaire;
    (c) Any employee medical complaints relative to exposure to hept

(d) A signed statement of any refusal to be examined;
(e) A copy of information provided to the physician pursuant to paragraph (k)(9)(ii) through (vi) of this section.

(iii) This record shall be maintained for the duration 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 and the Director.

(ii) Employee exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(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.

(m) Observation of monitoring.

(1) Duty.

The employer shall give affected employees or their representatives an opportunity to observe any monitoring of employee exposure to heptane which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to heptane requires entry into an area where the use of personal protective devices is required, the observer shall use such equipment and comply with all other applicable safety procedures.

(ii) Without interfering with the measurement, observers shall be entitled to:
(a) Receive an explanation of the measurement procedures;
(b) Visually observe all steps related to the measurement of exposure to heptane that are being performed at the place of exposure.
(c) Record the results obtained.

(n) Employee notification.

(1) The employer shall notify in writing, within five work days, every employee who is found to be exposed to heptane above the permissible exposure. The employee shall also be notified of the level of his exposure and the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(2) Pursuant to paragraph (k) of this Section, when an employee is medically examined the employer shall provide the employee with a copy of the physician's written opinion.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Heptane (n-heptane)

PERMISSIBLE EXPOSURE: 500 parts of heptane per million parts of air (ppm) or 2000 milligrams of heptane per cubic meter of air (mg/cu m)

APPEARANCE AND ODOR: Colorless liquid with a mild gasoline-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Heptane can affect your body if you inhale it or if it comes in contact with your skin or eyes or if you swallow it.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to heptane may cause slight irritation of the eyes, nose and throat, lightheadedness, hilarity, semi-consciousness and dizziness. It may also cause loss of appetite and nausea. Higher concentrations may cause unconsciousness.
2. Long-Term Overexposure: Prolonged overexposure to the liquid may cause skin irritation.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with heptane exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If heptane gets into your eyes, wash the 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 heptane gets on your skin promptly wash the contaminated skin using soap or mild detergent. If heptane soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists after washing get medical attention. Do not wear the clothing again until the heptane is removed. Replace or repair impervious clothing that has developed leaks.

C. Breathing: If you or any other person breathes in large amounts of heptane remove 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: If heptane has been swallowed do not cause vomiting. 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 heptane. You can only be required to wear them for routine use if your employer is in the process of installing controls or if 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)/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 heptane while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid heptane.

C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash-proof goggles) where eye contact to liquid heptane may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Heptane is a flammable liquid and its vapors easily form explosive mixtures with air.

B. Heptane must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames and strong oxidizers.

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

D. You must use non-sparking tools when opening or closing metal containers of heptane, and containers must be bonded and grounded when pouring or transferring liquid heptane.

E. If your skin becomes wet with liquid heptane, you must promptly wash or shower using soap or mild detergent to remove the heptane from your skin.

F. Clothing wet with heptane can be easily ignited. You must immediately remove any clothing that becomes wet with liquid heptane and this clothing must not be reworn until the heptane is removed from the clothing.

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

H. Ask your supervisor where heptane is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
HEPTANE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Normal heptane
2. Formula: $CH_3(CH_2)_5CH_3$
3. Molecular weight: 100

B. Physical Data

1. Boiling point (760 mm Hg): 98.4 C (209 F)
2. Specific gravity (water=1): 0.7
3. Vapor density (air=1 at boiling point of heptane): 3.5
4. Melting point: -90.6 C (-132 F)
5. Vapor pressure at 20 C (68 F): 40 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.005
7. Evaporation rate (butyl acetate=1): data not available
8. Appearance and odor: Colorless liquid with a mild gasoline-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: -3.9 C (25 F) (closed cup)
2. Autoignition temperature: 215 C (419 F)
3. Flammable limits in air, % by volume: Lower: 1.05; Upper: 6.7
4. Extinguishing media: Dry chemical, foam, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Heptane is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where heptane is handled, used or stored. Heptane vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which heptane is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, heptane is classified as a Class IB flammable liquid. At 2625 ppm, one-fourth of the lower flammable limit, heptane is considered to be a potential fire and explosion hazard.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for heptane shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving heptane.
4. Special precautions: Heptane will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If heptane is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources
2. Ventilate area of spill or leak
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood duct work, then burn the paper. Large quantities may be collected and atomized in a suitable combustion chamber. Heptane may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

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

C. Waste disposal methods:
Heptane may be disposed of by 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 average eight-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of heptane to plus or minus 35%.

b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of heptane to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

A. Store heptane in tightly closed containers in a cool, well-ventilated area.

B. High exposures to heptane can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal heptane containers. These containers must be effectively grounded and bonded prior to pouring.

D. Employers must advise employees of all plant areas and operations where exposure to heptane could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to heptane is likely to occur are: during its production; in the use and handling of gasoline which contains heptane; its use as a solvent for inks, rubber cements, lacquers; its use as an extractant of oils from seeds, resin from wood, tallow from meat scraps; and its use as an intermediate in the large-scale synthesis of toluene, and in the manufacture, use, and testing of industrial and motor fuels and lubricants.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Heptane vapor is a narcotic. Concentrations of 10,000 to 15,000 ppm produced narcosis in mice within 30 to 60 minutes, while 15,000 to 20,000 ppm caused convulsions and death. At 48,000 ppm respiratory arrest was produced in mice in 3 to 4 minutes from the start of exposure. Human subjects exposed to 1,000 ppm for 6 minutes, or to 2,000 ppm for 4 minutes, reported slight vertigo. At 5,000 ppm for 4 minutes, there was marked vertigo, inability to walk a straight line, hilarity and incoordination, but no complaints of eye and upper respiratory tract or mucous membrane irritation. A 15 minute exposure at 5,000 ppm produced in some subjects a state of stupor lasting for 30 minutes after exposure. These subjects also reported loss of appetite, slight nausea, and a taste resembling gasoline for several hours after exposure. The liquid is a defatting agent, and prolonged exposure may cause irritation of the skin. Aspiration may cause a chemical pneumonia. No chronic systemic effects have been reported in humans.

III. SIGNS AND SYMPTOMS

Lightheadedness, giddiness, stupor; loss of appetite and nausea; dermatitis may occur from prolonged skin exposure to the liquid. Aspiration of liquid may cause a chemical pneumonia.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap and water. Do not induce vomiting if swallowed. Give artificial resuscitation if indicated. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of heptane are caused by its narcotic properties. It is important that the physician becomes familiar with plant operating conditions in which exposure to heptane 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

Routine medical histories and physical examination are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from heptane exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Skin disease -- Heptane is a skin defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

2. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of heptane might cause exacerbation of symptoms due to its irritant properties.

3. Liver disease -- Although heptane is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

4. Kidney disease -- Although heptane is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above listed conditions, he must refer such employee for further medical examination.

References

1. American Conference of Governmental Industrial Hygienists: "Heptane," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 124.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1198-1199.

3. Hygienic Guide Series: "Heptane," American Industrial Hygiene Association Journal, 20:69-70, 1959.

4. Swann, H. E., Jr., et al.: "Acute Inhalation Toxicology of Volatile Hydrocarbons," American Industrial Hygiene Association Journal, 35:511-518, 1974.

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(d) Methods of Compliance - Open surface tank classification based on relative evaporation rate of 2 hours. A. K. Doolittle, "The Technology of Solvents and Plasticizers", John Wiley & Sons, Inc., New York, 1954, pp. 354-357.

(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. 15.

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

Eye: AIHA Hyg. Guide; Exxon MSDS; Grant, "Toxicology of the Eye"

Skin: Patty, "Ind. Hyg. and Tox."; Sax, "Dangerous Properties of Ind. Materials"; and AIHA Hyg. Guide

Ingestion: Sax, "Dangerous Properties of Ind. Materials;" AIHA Hyg. Guide

COMMENTS

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

Grant reports in general for mixtures of hydrocarbons that " various liquid hydrocarbons of petroleum cause little or no injur on direct external contact with the eye. In particular, kerosene Deo-base, Stoddard solvent, and petroleum oil on rabbit and human corneas are essentially innocuous. Liquid petrolatum and purifie deodorized kerosene such as used for insecticide solvent can be a to human eyes without causing discomfort or signs of irritation.

"More volatile derivatives, high-test gasoline in particular cause smarting and pain on splash contact with the eye, but only slight transient corneal epithelial disturbance." He adds that p butane injected into the anterior chamber of rabbits as a gas caused no disturbance.

For solvents, Grant states "A splash of a chemically inert solvent usually causes immediate stinging and smarting pain, and may cause loss of some or all of the corneal epithelium, particul if it is a good fat solvent, but as a general rule it does not da the corneal stroma underlying the epithelium. Even if all the epithelium is lost from the cornea as a result of splash of ordin organic solvents, it generally regenerates in a few days without residual permanent damage. While the epithelium is missing, the stroma may be slightly swollen and the posterior surface of the c may appear wrinkled."

AIHA simply says to flush eyes immediately. Exxon MSDS says to "flush eyes with water until irritation subsides."

A classification of 2 is concluded appropriate to prevent the possible effects cited.

Skin - Classification: 2
Output statement numbers: 2, 7b, 16i, 21
Exceptions: None

Patty notes in general that "the liquid paraffin hydrocarbons are fat solvents and primary skin irritants. Repeated or prolonge

skin contact will dry and defat the skin, resulting in irritation and dermatitis."

Sax lists it as being a chronic local irritant of slight toxic hazard. AIHA agrees with the above.

Heptane has a vapor pressure of 40 mm Hg at 20 degrees C. I has a flash point of 25 degrees F and is 0.005% soluble in water.

A classification of 2 is concluded appropriate to prevent the possible effects cited.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

Sax lists the acute systemic effects of ingestion of the var to be of slight toxic hazard. The AIHA Hygienic Guides for hexan heptane report "the paraffin hydrocarbons are anesthetic agents a mucuous membranes, but do not cause systemic toxicity."

It is concluded that ingestion of this substance, in the con of this standard, would not be a hazard in the industrial environ

SUBSTANCE TECHNICAL GUIDELINES

DIOXANE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Diethylene dioxide; diethylene ether; dioxan; p-dioxane; 1,4-dioxane
2. Formula: $OCH_2CH_2OCH_2CH_2$
3. Molecular weight: 88

B. Physical Data

1. Boiling point (760 mm Hg): 101 C (214 F)
2. Specific gravity (water=1): 1.03
3. Vapor density (air=1 at boiling point of dioxane): 3.0
4. Melting point: 11.8 C (53 F)
5. Vapor pressure at 20 C (68 F): 29 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): 2.7
8. Appearance and odor: Colorless liquid with a mild ether-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 12 C (54 F) (closed cup)
2. Autoignition temperature: 180 C (356 F)
3. Flammable limits in air, % by volume: Lower: 2.0; Upper: 22.0
4. Extinguishing media: Dry chemical, alcohol foam, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Dioxane is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where dioxane is handled, used or stored in a manner that could create a potential fire or explosion hazard. Dioxane vapors are heavier than air and may travel along the ground and be

ignited by open flames or sparks at locations remote from the site at which dioxane is handled.

7. For purposes of conforming with the requirements of 29 CFR 1910.106, dioxane is classified as a Class IB flammable liquid. For example, 5000 ppm, approximately one-fourth of the lower flammable limit, is one situation in which dioxane is considered to be a potential fire and explosion hazard.

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

B. Reactivity

1. Conditions contributing to instability: Heat, long exposure to moisture.

2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving dioxane.

4. Special precautions: Dioxane is hygroscopic and will produce peroxides in the presence of moisture. Dioxane containing peroxides should not be distilled to dryness because of the potential explosion of non-volatile peroxides.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If dioxane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources

2. Ventilate area of spill or leak

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood duct work, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Dioxane may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

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

C. Waste disposal methods: Dioxane may be disposed of by 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 average eight-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone

(air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of dioxane to plus or minus 35%.

b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of dioxane to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

A. Store dioxane in tightly closed containers in a cool, well-ventilated area.

B. High exposures to dioxane can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal dioxane containers. These containers must be effectively grounded and bonded prior to pouring.

D. Dioxane in storage must be checked for peroxide content in accordance with manufacturers' recommendations.

E. Employers should advise employees of all plant areas and operations where exposure to dioxane could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to dioxane is likely to occur are: Its use as a solvent for resin-based varnishes, lacquers, paints, fats, oils, waxes, greases, resins; its use as a solvent in the pulping of wood; its use as a wetting agent and degreaser; in the formulation and use of paint and varnish removers; its use in the preparation of cosemetics, deodorants and detergents; and its use in purifying drugs.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Heptane

D.O.L. STANDARD: 500 ppm

WARNING PROPERTIES:

Odor Threshold: Summer reports an odor threshold pf 220 ppm; Staub reports 50 and 220 ppm.

Eye Irritaion Level: Heptane is not known to be an eye irritant.

Evaluation of Warning Properties: Since the odor threshold of heptane is well below the permissible exposure limit, heptane is treated as a mater with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 5000 ppm

Basis for IDLH Value: This IDLH is based upon the report in Patty that a 15-minute exposure to 5000 ppm heptane "produced a state of intoxication characterized by uncontrolled hilarity in some individuals and in others a stupor lasting for 30 minutes after the exposure." According to Patty a 4-minute exposure to this same concentration produces vertigo and incoordination. These symptoms described in Patty could perhaps impede

escape.

Other Toxicological Information: Patty reports that "Heptane, in concentrati of 10,000 to 5000 ppm (1 to 1.5 per cent), produces narcosis in mice within 30 to 60 minutes. At higher concentrations, 15,000 to 20,000 ppm (1.5 to 2 per cent), a 30- to 60-minute exposure caused convulsions and death in mice. Slight vertigo developed in men exposed for 6 minutes to 1000 ppm (0.1 per cent) and for 4 minutes to 2000 ppm (0.2 per cent). A 4-minute exposure to 5000 ppm (0.5 per cent) heptane caused marked ver inability to walk a straight line, hilarity and incoordination. It is significant that these signs and symptoms of systemic effects were produced in the absence of evidence or complaints of mucous membrane irr tation. A 15-minute exposure to heptane at tnis concentration produced state of intoxication characterized by uncontrolled hilarity in some individuals and in others a stupor lasting for 30 minutes after the expo These symptoms were frequently intensified or first noticed at the momen of entry into an uncontaminated atmosphere. The individuals also compla of loss of appetite, slight nausea, and a taste resembling gasoline for several hours after exposure to heptane."

LFL: 10,500 ppm

VAPOR PRESSURE AT 20 C: 40 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 52,600 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEPTANE

USE/EXPOSURE AND CONTROL DOCUMENT
HEPTANE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during use as an industrial solvent (carrier and penetrant solvent for adhesives, used in azeotropic distillations, in rubber tire manufacture, as solvent for rubber cements, in azeotropic distillations)	A,B	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
2.	Inhalation of vapor and skin contact with liquid during use as an ink solvent in gravure printing (exposure during manufacture, storage and use)	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
3.	Inhalation of vapor and skin contact with liquid during use as an diluent solvent for lacquers (exposure in preparation and application - spray or hand)	A,B	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
4.	Inhalation of vapor and skin contact with liquid during use in the polymer industry (as solvent for manufacture of polypropylene and other polyolefins, as a swelling agent, as a blowing agent for plastic foams)	A,B	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
5.	Inhalation of vapor and contact with liquid during use as a reference fuel. Heptane is a constituent of most fuels for gasoline engines. It is a standard for testing gasoline engine knock (octane number = 0),	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice

	and is used for pollution and combustion studies.		
6.	Inhalation of vapor and skin contact with liquid during preparation of heptane by petroleum fractionation (exposure at refineries at solvent processing units, in filling tank cars, drums, and other containers.)	A,B	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
7.	Inhalation of vapor and skin contact with liquid during use in organic chemical synthesis (hydroforming process for the preparation of toluene, used in preparation of alkylbenzenes)	A,B	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
8.	Inhalation of vapor and skin contact with liquid during use as an extraction solvent (tallow from meat scraps, rosin from wood, oils from seeds)	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
9.	Inhalation of vapor and skin contact with liquid during use for cleaning surfaces before application of adhesives	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice
10.	Inhalation of vapor and skin contact with liquid during cleaning and maintaining of storage tanks	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (goggles, gloves, respirator, apron)
11.	Inhalation of vapor and skin contact with liquid during use as a laboratory solvent for scientific testing	A,B	Local exhaust ventilation general dilution ventilation; personal protective equipment (goggles, gloves); good personal hygiene practice

A -- Inhalation
B -- Skin contact resulting in

localized irritation
C -- Ingestion
D -- Skin contact resulting in absorption and subsequent systemic poisoning