NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** METHYLCYCLOHEXANE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for METHYLCYCLOHEXANE

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 METHYLCYCLOHEXANE.

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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for METHYLCYCLOHEXANE

(a) DEFINITIONS

(1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of methylcyclohexane 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 methylcyclohexane.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which methylcyclohexane 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 METHYLCYCLOHEXANE - Inform affected employees of the quantity, location, and manner of use or storage of methylcyclohexane.

(c) EXPOSURE MEASUREMENT

(1) INITIAL DETERMINATION - Each employer who has a place of employment in which methylcyclohexane is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of methylcyclohexane 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 methylcyclohexane. 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 methylcyclohexane;

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

(iii) Any employee complaints of symptoms which may be attributable to exposure to methylcyclohexane; 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 methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane is present in concentrations greater than 3000 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 methylcyclohexane 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 METHYLCYCLOHEXANE

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 a chin-style organic vapor canister.
Equal to or less than 5000 ppm	Any supplied-air respirator. Any self containted breating apparatus
Equal to or less than 10,000 ppm	A gas mask with a front- or back-mounted organic vapor canister. Any supplied air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 10,000 ppm or escape and or other entry from unknown	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

concentrations	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 p 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 methylcyclohexane which is contained in Appendix B in order to ensure the safe handling and use of methylcyclohexane.

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

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, methylcyclohexane 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 methylcyclohexane shall be Class I Group D.

(4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid methylcyclohexane is classified as a Class IB flammable liquid. Spray finishing operations 1910.94(c). 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 methylcyclohexane is handled, used or stored in a manner so as to create a potential fire or explosion hazard.

(6) Storage - Methyl cyclohexane 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 methylcyclohexane. Face shields shall comply with section 1910.133(a)(6).

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

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

(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 methylcyclohexane may occur.

(h) Spills

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

(2) Liquid methylcyclohexane 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 methylcyclohexane promptly wash or shower using soap or mild detergent to remove any methylcyclohexane from the skin.

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

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

(2) Medical -

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

(II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to methylcyclohexane 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 methylcyclohexane.

(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 liquid methylcyclohexane, or airborne concentrations of methylcyclohexane at or above the action level, a written statement as to whether such employee has a history of any of the following:

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

(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 methylcyclohexane 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 methylcyclohexane.

(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 methylcyclohexane;
(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 methylcyclohexane 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 methylcyclohexane.

(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 methylcyclohexane.

(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 methylcyclohexane.

(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 methylcyclohexane 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 meth
(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 methylcyclohexane which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane 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.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE: Methylcyclohexane

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

APPEARANCE AND ODOR: Colorless liquid with a faint, benzene-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Methylcyclohexane 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 methylcyclohexane may cause lightheadedness and drowsiness. It may also cause slight irritation of the eyes, nose and throat. At high air concentrations it may cause unconsciousness and death.
2. Long-Term Overexposure: Prolonged exposure to the liquid may cause irritation of the skin.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with methylcyclohexane exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If methylcyclohexane 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 methylcyclohexane gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If methylcyclohexane 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 methycyclohexane has been removed. Replace or repair impervious clothing that has developed leaks.

C. Breathing: If you or any other person breathes in large amounts of methylcyclohexane 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: When methylcyclohexane 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 methylcyclohexane. 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 methylcyclohexane 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 methylcyclohexane.

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

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

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

B. Methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane, and containers must be bonded and grounded when pouring or transferring liquid methylcyclohexane.

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

F. Clothing wet with methylcyclohexane can be easily ignited. You must immediately remove any clothing that becomes wet with liquid methylcyclohexane and this clothing must not be reworn until the methylcyclohexane 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 methylcyclohexane is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
METHYLCYCLOHEXANE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Cyclohexylmethane; hexahydrotoluene
2. Formula: C_7H_{14}
3. Molecular weight: 98

B. Physical Data

1. Boiling point (760 mm Hg): 101 C (214 F)
2. Specific gravity (water=1): 0.77
3. Vapor density (air=1 at boiling point of methylcyclohexane): 3.4
4. Melting point: -126 C (-196 F)
5. Vapor pressure at 20 C (68 F): 37 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Insoluble
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance and odor: Colorless liquid with a faint, benzene-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: -3.9 C (25 F) (closed cup)
2. Autoignition temperature: 250 C (482 F)
3. Flammable limits in air, % by volume: Lower: 1.2; 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: Methylcyclohexane is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where methylcyclohexane is handled, used or stored. Methylcyclohexane 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 methylcyclohexane is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, methylcyclohexane is classified as a Class IB flammable liquid. At 3000 ppm, one-fourth of the lower flammable limit, methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane.
4. Special precautions: Methylcyclohexane will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If methylcyclohexane 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. Methylcyclohexane 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:
Methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

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

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

C. Non-sparking tools must be used to open and close metal methylcyclohexane 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 methylcyclohexane could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to methylcyclohexane is likely to occur are: its use as a solvent in some polymerization reactions; as an intermediate in the chemical synthesis of toluene; as a solvent for some lacquers, rubbers, coatings, paints, oils, waxes, and inks; and as a degreasing agent.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Methylcyclohexane vapor is a mild narcotic. Concentrations of 10,000 to 12,500 ppm were fatal to mice. Rabbits exposed to 3,330 ppm for 300 hours showed minor evidence of liver and kidney injury, while 1,200 ppm was innocuous for rabbits, and prolonged exposure at 370 ppm was harmless to monkeys. No toxic effects from industrial exposure have been reported. Prolonged or repeated skin contact may produce drying and irritation due to defatting action.

III. SIGNS AND SYMPTOMS

May produce lightheadedness and drowsiness; skin irritation from prolonged exposure; slight irritation of nose and throat.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

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

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Methylcyclohexane has narcotic and mild irritant properties. It is important that the physician becomes familiar with plant operating conditions in which exposure to methylcyclohexane 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 methylcyclohexane exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Skin disease -- Methylcyclohexane 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. Liver disease -- Although methylcyclohexane 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.

3. Kidney disease -- Although methylcyclohexane 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.

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

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: "Methylcyclohexane," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 162-163.

2. Browning, Ethel: "Toxicity and Metabolism of Industrial Solvents," Elsevier Publishing Company, Amsterdam, 1965, pp. 135137.

3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1211-1212.

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(d) Methods of Compliance - Open surface tank classification based on relative evaporation rate of 2.5 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.

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

Eye: Sax, "Dangerous Properties of Ind. Materials;" Phillips Petroleum Co MSDS; Grant, "Toxicology of the Eye"

Skin: Treon, J. F., Crutchfield, W. E., Kitzmiller, K. V., "The Physiological Response of Rabbits to Cyclohexane, Methylcyclohexane, and Certain Derivatives of These Compounds: I. Oral Administration and Cutaneous Application," Journal of Ind. Hyg. and Tox., Vol. 25, N International Labour Office, "Encyclopedia of Occupational Health and Safety"

Ingestion: Browning, "Tox. and Metabolism of Ind. Solvents;" Gleason, "Clinical Toxicology of Commercial Products"

COMMENTS

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

Sax, referring to its vapors, says "this material does not cause irritation to the eyes and nose." Phillips MSDS states tha "liquid contact with the eye may produce moderate irritation." Grant reports in general for solvents that a splash in the eye ma cause loss of the epithelium but that regeneration and complete recovery occurs in a few days.

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

Treon et al. note that repeated cutaneous application causes slight temporary local irritation and thickening of the skin and that the material does not appear to be absorbed in harmful amoun

ILO reports in general for cycloparaffins that "they have an irritant and defatting action on the skin."

Methylcyclohexane has a vapor pressure of 37 mm Hg at 20 deg It is insoluble in water and has a flash point of 25 degrees F.

A classification of 2 is concluded to be appropriate.

Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None

Browning gives an oral MLD for rabbits of 4 - 4.5 g/kg. The outstanding symptom of ingestion is diarrhea and there has be some evidence of widespread general vascular injury. It is furth noted that no cases of toxic effects from industrial exposure hav been reported. Gleason agrees with the above and adds that "dege

rative lesions are seen in kidney and liver." The MLD given abov
if applied to humans, classifies this substance as moderately tox
The moderate toxicity of the compound and its vapor pressure
lead to the conclusion that ingestion, in the context of this sta
would not present a hazard in the industrial environment.

SUBSTANCE TECHNICAL GUIDELINES
METHYLCYCLOHEXANE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Cyclohexylmethane; hexahydrotoluene
2. Formula: C_7H_{14}
3. Molecular weight: 98

B. Physical Data

1. Boiling point (760 mm Hg): 101 C (214 F)
2. Specific gravity (water=1): 0.77
3. Vapor density (air=1 at boiling point of methylcyclohexane): 3.4
4. Melting point: -126 C (-196 F)
5. Vapor pressure at 20 C (68 F): 37 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Insoluble
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance and odor: Colorless liquid with a faint, benzene-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: -3.9 C (25 F) (closed cup)
2. Autoignition temperature: 250 C (482 F)
3. Flammable limits in air, % by volume: Lower: 1.2; 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: Methylcyclohexane is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where methylcyclohexane is handled, used or stored in a manner that could create a potential fire or explosion hazard. Methylcyclohexane 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 methylcyclohexane is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, methylcyclohexane is classified as a Class IB flammable liquid. For example, 3000 ppm, approximately one-fourth of the lower flammable limit, is one situation in which methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane.
4. Special precautions: Methylcyclohexane will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If methylcyclohexane 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. Methylcyclohexane 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: Methylcyclohexane 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 methylcyclohexane 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 methylcyclohexane to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

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

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

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

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

VI. COMMON OPERATIONS

Common operations in which exposure to methylcyclohexane is likely to occur are: Its use as a solvent in some polymerization reactions; as an intermediate in the chemical synthesis of toluene; as a solvent for some lacquers, rubbers, coatings, paints, oils, waxes, and inks; and as a degreasing agent.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Methylcyclohexane

D. O. L. STANDARD: 500 ppm

WARNING PROPERTIES:

Odor Threshold: Sax states that at the level of 500 ppm methylcyclohexane "exhibits only a very faint odor."

Irritation Levels: Sax states that "this material does not cause irritation to the eyes and nose."

Evaluation of Warning Properties: At concentrations within two or three times the permissible exposure limit, methylcyclohexane can be detected through its odor. For the purposes of this standard, methylcyclohexane is treated as a material with adequate warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 10,000 ppm

Basis for IDLH Value: With no reported human intoxication data, the IDLH is based upon the report in Browning that Treon was able to produce light narcosis in mice at 10,054 ppm. Browning also states that Lazareu found the narcotic dose for mice to be 7500 - 10,000 ppm. The Documentation of TLV's notes that this narcotic dose is for a 2-hour exposure.

Other Toxicological Information: Browning reports that "no toxic effects from industrial exposure (to methylcyclohexane) have been reported," and "no case of intoxication in human beings has been recorded." Methylcyclohexane does have a narcotic effect. By inhalation, the acute lethal dose is reported by Lazareu to be 10,000 to 12,500 ppm for mice, and the narcotic dose 7500 - 10,000 ppm. "Treon et al. were able to produce rapid narcosis by inhalation of 59.9 mg/l (15,227 ppm) and light narcosis by 39.5 mg/l (10,054 ppm)."

The Documentation of TLV's, in describing Lazareu's experiment, states that "inhalation at a concentration of 7500 to 10,000 ppm for two hours caused prostration in white mice, and 10,000 to 12,500 ppm was fatal. . . The TLV of 500 ppm should afford an exposure without significant narcosis and be well below the level causing other toxic effects."

LFL: 12,000 ppm

VAPOR PRESSURE AT 20 C: 37 mm Hg
SATURATED CONCENTRATION AT 20 C: Approximately 48,700 ppm

USE/EXPOSURE AND CONTROL DOCUMENT
METHYLCYCLOHEXANE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during spray application of lacquers (Used as a diluent solvent for cellulose)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (gloves, respiratory protective device, gloves)
2.	Inhalation of vapor during coating application with resins and rubbers (wire coating, textile coating)	A	General dilution ventilation; mechanical ventilation may be desirable
3.	Inhalation of vapor and skin contact with liquid during brush and hand application of synthetic varnishes, lacquers, and paint	A,B	General dilution ventilation; mechanical ventilation may be desirable; personal protective equipment (gloves)
4.	Inhalation of vapor and skin contact with liquid during manufacture, storage, and use of rotogravure inks	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (gloves)
5.	Inhalation of vapor and skin contact with liquid during use as a solvent for oils, fats, waxes, and rubbers	A,B	General dilution ventilation; mechanical ventilation may be desirable; personal protective equipment (gloves, aprons); good personal hygiene practice
6.	Inhalation of vapor and skin contact with liquid during use in resin molding (used as a diluent)	A,B	General dilution ventilation; mechanical ventilation may be desirable; personal protective equipment (gloves); good personal hygiene practice
7.	Inhalation of vapor and skin contact with liquid during use as a degreasing agent	A,B	General dilution ventilation; mechanical ventilation if necessary; personal protective equipment (gloves); good personal hygiene practice
8.	Inhalation of vapor and	A,B	Personal protective equip-

	skin contact with liquid during cleaning and repair of storage vessels		ment (gloves, respiratory protective devices); good personal hygiene practice
9.	Inhalation of vapor and skin contact with liquid during use in industrial organic synthesis (used principally for the synthesis of toluene by the hydroreforming process)	A,B	Process enclosure; local exhaust ventilation

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