

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** HEXONE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

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 HEXONE.

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 HEXONE

- (1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of hexone in concentrations not in excess of 100 parts per million (ppm) (410 milligrams per cubic meter, mg/cu.m.) averaged over an 8-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 hexone.
- (b) EMPLOYEE INFORMATION - Each employer who has a workplace in which hexone is present shall:
 - (1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices at the workplace. This material shall be made readily available to affected employees; and
 - (2) PRESENCE OF HEXONE - Inform affected employees of the quantity, location, and manner of use or storage of hexone.
- (c) EXPOSURE MEASUREMENT
 - (1) INITIAL DETERMINATION - Each employer who has a place of employment in which hexone is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of hexone 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 hexone. 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 hexone;
 - (ii) Any measurements of airborne concentrations of hexone taken;
 - (iii) Any employee complaints of symptoms which may be attributable to exposure to hexone; 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 hexone 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 hexone 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 hexone 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

concentrations of hexone 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 hexone 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 hexone 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 hexone 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 hexone is presenting concentrations greater than 3500 ppm, one fourth of the lower flammable limit, the fan rotating element shall be of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(iii) In the design of open surface tank ventilation for the purposes of compliance with section 1910.94(d), operations involving hexone shall be classified as B-2 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

- (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 employee 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),(f) and (g).

TABLE 2. RESPIRATORY PROTECTION FOR HEXONE

Condition	Permissible Respiratory Protection
Vapor Concentration	
Equal to or less than 1000 ppm	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).
Equal to or less than 5000 ppm	A gas mask with a chin-style organic vapor canister. A gas mask with a front or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, hood or helmet. Any self-contained breathing apparatus with a full facepiece.
Greater than 5000 ppm, or Entry and Escape from Unknown Concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode. A combination respirator which includes a type C any supplied-air respirator with a full facepiece operated in pressure-demand (positive pressure) or continuous flow mode and an auxiliary self-contained air supply operated in pressure-demand mode.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

Fire Fighting Self-contained breathing apparatus with a full face-
 piece operated in pressure-demand (positive pressure)
 mode.

Escape
Any gas mask providing protection against organic
vapors.

(f) Fire and Safety

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

- (1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of hexone shall be Class I Group D.
- (2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, hexone 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 hexone shall be Class I Group D.
- (4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid hexone is classified as a Class IC 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 hexone is used, handled or stored in a manner so as to create a potential fire or explosion hazard.

(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 hexone. Face shields shall comply with section 1910.133(a)(6).
- (ii) Employers shall ensure that clothing contaminated with hexone is placed in closed containers. Employers shall provide for the cleaning or disposal of such clothing and if the clothing is to be laundered or otherwise cleaned, shall inform the person performing this operation of the hazardous properties of hexone.
- (iii) Employers shall ensure that non-impervious clothing which becomes wet with hexone be removed promptly and not reworn until the hexone is removed from the clothing.
- (iv) Employers shall ensure that clothing which becomes wet with hexone be removed immediately and not reworn until the hexone is removed from the clothing.

(2) Eye Contact

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

- (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 hexone may occur.
- (h) Spills
 - (1) Spills of hexone shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.
 - (2) Liquid hexone 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 hexone promptly wash or shower as necessary to remove any hexone from the skin.
 - (2) Where skin contamination may occur and showers are required for adequate cleaning of the body, employers shall provide showers as described in section 1910.141(d)(3).
- (j) Training and Information - Each employer who has employees exposed to hexone in excess of the action level, or employees who may have skin or eye contact with liquid hexone, or employees who work where accidental release, spill, fire, or explosion of hexone may occur, shall annually:
 - (1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for hexone, which is contained in Appendix A; and
 - (2) Medical -
 - (I) Advise employees as to the signs and symptoms of exposure to hexone.
 - (II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to hexone 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 insure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to hexone.
 - (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 hexone, or airborne concentrations of hexone at or above the action level, a written statement as to whether such employee has a history of any of the following:
 - (i) Liver disease
 - (ii) Chronic lung disease
 - (iii) Skin disease
 - (iv) Kidney disease

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

(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 hexone.

(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 be exposed to hexone 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 hexone.

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

(i) A copy of this regulation for hexone;

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

(iii) A description of any personal protective equipment 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 hexone 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 hexone.

(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 hexone.

(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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

from the employee indicating that the employee understands the risks involved by refusing to be examined.

(1) 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 for at least one year.

(2) Exposure measurements.

- (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to hexone.
- (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 hexone 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 for 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 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 for at least one year.

(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 hex

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

- (d) A signed statement of any refusal to be examined;
- (e) A copy of information provided to the physician pursuant to paragraph (k)(9) 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 hexone which is conducted pursuant to this section.
 - (2) Exercise of opportunity to observe monitoring.
 - (i) When observation of the monitoring of employee exposure to hexone 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 hexone 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 hexone 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Hexone

PERMISSIBLE EXPOSURE: 100 parts of hexone vapor per million parts of air (p)
or 410 milligrams per cubic meter of air (mg/cu m).

APPEARANCE AND ODOR: Colorless liquid with a pleasant odor.

II. HEALTH HAZARD DATA

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

B. Effects of Overexposure:

1. Short-Term Effects: Hexone may cause irritation of the eyes, nose, throat, and respiratory tract. Exposure to high concentration may cause nausea, headaches, dizziness or unconsciousness.
2. Long-Term Effects: Prolonged or repeated skin contact may cause dryness and irritation of your skin.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with hexone exposure.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If hexone gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If hexone gets on your non-impervious clothing or skin remove and clean the contaminated clothing and flush the contaminated skin with water promptly. If skin irritation is present, get medical attention.
- C. Breathing: If you or any other person breathes in large amounts of hexone 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

- D. Swallowing: If the person is not unconscious and hexone 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 hexone. You can only be required to wear them for routine use if your employer is in the process of installing controls or other 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.)

If you can smell hexone 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, and other appropriate protective clothing over any parts of your body that could repeatedly be exposed to hexone liquid.
 - C. EYE PROTECTION: You must wear splash-proof safety goggles if it is possible that hexone may get into your eyes.
- V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE
- Hexone is a flammable liquid and must be stored in tightly closed containers, in a cool, well-ventilated area, away from ignition sources and strong oxidizing agents. Hexone metal storage containers must be grounded and bonded when transferring hexone and you must use non-sparking tools to open and close them. You must not smoke where hexone is used, handled or stored. If your clothing becomes wet with hexone, you must promptly remove the wet clothing and not wear it again until the hexone is removed. If your skin becomes wet with hexone, you must wash or shower promptly. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where hexone is used in your work area and for any additional plant safety rules.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
HEXONE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 4-methyl-2-pentanone; methyl isobutyl ketone; isobutyl methyl ketone; MIBK
2. Formula: CH3COCH2C3H7

B. Physical Data

1. Boiling point (760 mm Hg): 116 C (244 F)
2. Specific gravity (water=1): 0.8
3. Vapor density (air=1): 3.5
4. Melting point: -84 C (-119 F)
5. Vapor pressure at 20 C (68 F): 15 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 1.9
7. Evaporation rate (butyl acetate=1): 1.64
8. Appearance and odor: Colorless liquid with a pleasant odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 22.8 C (73 F) (closed cup)
2. Autoignition temperature: 460 C (860 F)
3. Flammable limits in air, % by volume: Lower: 1.4; Upper: 7.5
4. Extinguishing media: Dry chemical, carbon dioxide or alcohol foam.
5. Special fire-fighting procedures: Do not use solid stream of water, since stream will scatter and spread fire. Use water spray to keep containers cool.
6. Unusual fire and explosion hazards: Hexone is a flammable liquid. Its vapors can form explosive mixtures in air. All ignition sources must be controlled when hexone is used, handled, and stored. hexone vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the hexone is handled.
7. For purposes of conforming to the requirements of 29 CFR 1910.106, hexone is classified as a Class IC flammable liquid. At 3500 ppm, one fourth of the lower flammable limit, hexone is considered a potential fire and explosion hazard.
8. For the purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

500 of the National Electrical Code for hexone 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 hexone.
4. Special Precautions: Dissolves some resins and rubbers.

III. SPILL AND LEAK PROCEDURES

A. If hexone 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) and burn the paper. Large quantities, can be collected and atomized in a suitable combustion chamber. Combustion may be improved by mixing with a more flammable liquid. Hexone 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:

Hexone may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.
2. By atomizing in a suitable combustion chamber. Combustion may be improved by mixing with a more flammable liquid.

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 in a fashion such that the average 8-hour exposure may be determined from a single 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 8-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 vapors adsorption tubes filters with subsequent chemical analyses, or dosimeters. The method of measurement must determine the concentration of hexone 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of hexone to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. High exposures to hexone can occur when transferring the liquid from one container to another.
- B. Non-sparking tools must be used to open metal hexone containers which must then be effectively grounded and bonded prior to pouring.
- C. Store hexone in tightly closed containers in a cool, well-ventilated area away from ignition sources and strong oxidizing agents.
- D. Employers must advise employees of all plant areas and operations where exposure to hexone could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to hexone is likely to occur are when it is used as a solvent in the manufacture or application of inks, lacquers and varnishes.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. Route of Entry

Inhalation; insignificant skin absorption

II. Toxicology

There is local irritation of mucous membranes. Skin irritation may occur because of the solvent effect of hexone on the lipids. Central nervous system depression may occur on exposure to high concentration. No chronic systemic effects reported.

III. Signs and Symptoms

Intense irritation of eyes and mucous membranes of upper respiratory tract; headache; narcosis leading to coma may occur at sustained high levels. Excessive skin contact may produce a dermatitis.

IV. Special Tests

None in common usage.

V. Treatment

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. Surveillance and Preventive Considerations

A. General

Most reported effects of hexone are caused by its irritant properties. It is important that the physician become familiar with plant operating conditions in which exposure to hexone 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 examinations 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 exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Renal disease -- Although hexone is not known as a kidney toxin, the importance of the organ in the elimination of

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

toxic substances and metabolites justifies special consideration in those with possible impairment of renal function.

2. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of hexone might cause exacerbation of symptoms due to irritant properties or psychic reflex bronchospasm.
3. Liver disease -- Although hexone 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. Skin disease -- Hexone is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of hexone.

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:

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3. Patty, F.A.: Industrial Hygiene and Toxicology, Volume II - Toxicology, Interscience Publishers, New York, 1962, pp. 1731-1733.
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NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

REFERENCES AND SOURCES

HEXONE
1910.93

- (f) Personal Protective Equipment, and (h) Sanitation
Eye: Patty, "Industrial Hygiene and Toxicology;" "Hexone,"
Union Carbide Corporation
Skin: Patty, "Industrial Hygiene and Toxicology;" "Hexone,"
Shell Chemical Corporation; "Hexone," Union Carbide
Corporation
Ingestion: Patty, "Industrial Hygiene and Toxicology;" "Hexone,"
AIHA Hygienic Guide Series; "Hexone," Shell Chemical Corporation

COMMENTS

- Eye - Classification: 2
Output statement numbers: 10
Exceptions: None
Patty notes that undiluted hexone "when in contact with
the eyes of rabbits has been reported to cause swelling and
irritation which subsides in a few days." Union Carbide rates
rabbit eye injury as "minor." A classification of 2 is concluded
to be appropriate since effects are reversible.
- Skin - Classification: 2
Output statement numbers: 2, 17g, 7b, 21, 17i
Exceptions: 20a deleted
Patty states that "repeated or prolonged skin contact may
result in a dermatitis, but short or occasional contacts should
cause essentially no irritation, unless confined to the skin as in
clothing or shoes." He continues, "hexone is not absorbed through
the skin in acutely toxic amounts." As for skin irritation, he
notes "liquid hexone has been shown to cause transient erythema
as the result of a single prolonged contact, especially when
confined to the skin." The Shell Chemical Corporation reports
"repeated daily applications of 10 ml of hexone to the skin of
rabbits resulted in dry and scaliness of the skin." Union Carbide
lists a single skin penetration LD50 for rabbits of more than
20 ml/kg. Hexone has a flash point of 73 degree F. It is 1.9%
soluble in water and has a vapor pressure of 15 mm Hg at 20 degrees
F.
A classification of 2 is clearly warranted to prevent repeated
or prolonged contact which may result in dermatitis or other
irritation. The mildness of its acute effects and its water-like
vapor pressure lead to the conclusion that statement 20a need not
be specified.
- Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None
Patty notes, "because this ketone is rapidly eliminated from the
body, no pathological effects are expected." The Hygienic Guide
Series state "hexone is only moderately toxic perorally to lab
animals, with an acute LD50 of 1600-3200 mg/kg for guinea pigs."
It continues, "higher doses are characterized by weakness, ataxia
and tremors." A rat single oral LD50 of 5.7 mg/kg (of the undiluted
compound) is given. The Shell Chemical Corporation lists an acute
rat LD of 2.08 g/kg. Since hexone is rapidly eliminated from the

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and Supporting Documentation for HEXONE

body and is only moderately toxic in acute exposures, it is concluded that it would not present a hazard in the industrial environment ingestion.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Hexone (Methyl Isobutyl Ketone)

D. O. L. STANDARD: 100 ppm

WARNING PROPERTIES:

Odor Threshold: According to Patty, all human volunteers exposed to the vapors of hexone for 5 minutes were able to detect the odor at concentrations less than 100 ppm hexone.

Eye Irritation Level: The AIHA Hygienic Guides report that the vapor of hexone is irritating to the eyes at 200 ppm.

Other Information: The AIHA Hygienic Guides report that at concentrations higher than 200 ppm, nose and throat irritation may occur.

Evaluation of Warning Properties: Through its odor and irritant effects, hexone can be detected at concentrations at and several times above the permissible exposure limit. For the purposes of this standard, therefore, hexone is treated as a material with adequate warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 3000 ppm

Basis for IDLH Value: Patty reports that "Smyth found rats survived a 4-hour exposure to methyl isobutyl ketone (hexone) at 2000 ppm; death occurred as a result of a 4-hour exposure to 4000 ppm." The AIHA Hygienic Guides state that "exposure of rats at 4000 ppm for four hours killed 6 of 6 and exposure at 2000 ppm for four hours killed 0 of 6 animals."

Other Toxicological Information: According to Patty, irritation and narcosis are the principal effects of exposure to concentrations of hexone in excess of the permissible exposure limit.

Mice exposed for 30 minutes to 19,500 ppm of methyl isobutyl ketone became anesthetized. They recovered consciousness rapidly when exposed to fresh air. At higher concentrations (above 20,000 ppm) deep anesthesia was induced with subsequent death of most animals. No gross pathology other than congestion of the lungs was seen in the mice that died. Smyth found rats survived a 4-hour exposure to methyl isobutyl ketone at 2000 ppm; death occurred as the result of a 4-hour exposure to 4000 ppm.

"Specht, working with guinea pigs, found that high concentrations of methyl isobutyl ketone (16,800 ppm) caused immediate symptoms of eye and nasal irritation followed by salivation, drunkenness, narcosis, and death. The breathing of concentrations of 1000 ppm caused a low grade narcosis in 6 hours. Death resulted after a 4-hour exposure to 10,000 ppm."

LFL: 14,000 ppm

VAPOR PRESSURE AT 20 C: 15 mm Hg

SATURATED CONCENTRATION AT 20 C: 19,750 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for HEXONE

USE/EXPOSURE AND CONTROL DOCUMENT
HEXONE

Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor during spray application of lacquer, varnish, epoxy, acrylic, vinyl, and other cellulose- or resin-based coatings, finishes, and adhesives	A	Local exhaust ventilation; personal protective equipment (organic vapor mask)
2. Inhalation of vapor during application of lacquer, varnish, epoxy, acrylic, vinyl, and other cellulose- or resin-based coatings, finishes, and adhesives by dipping, roller coating, tumbling, knifing, or brushing	A	Local exhaust ventilation; general dilution ventilation
3. Inhalation of vapor during oven or air drying of coatings, finishes, and adhesives	A	General dilution ventilation
4. Inhalation of vapor and skin contact with liquid during manual application of cellulosic, acetate, acrylic, and rubber adhesives in shoe manufacturing, book-binding, packaging, and furniture making	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, aprons)
5. Inhalation of vapor during application of cellulose cements	A	General dilution ventilation
6. Inhalation of vapor and skin contact with liquid during blending of raw materials for molded plastics, such as polystyrene, acrylate, and vinyl	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, aprons)
7. Inhalation of vapor during use as separating agent for certain inorganic salts and to separate plutonium from uranium, niobium from	A	General dilution ventilation

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and Supporting Documentation for HEXONE

tantalum, and zirconium
from hafnium

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| 8. | Inhalation of vapor during extraction in manufacture of antibiotics, in separation of ethanol or butanol from isopropanol, and in purification of petroleum products (dewaxing) | A | General dilution ventilation |
| 9. | Inhalation of vapor during manufacture of dry cleaning preparations, germicides, fungicides, and electroplating solutions | A | General dilution ventilation |
| 10. | Inhalation of vapor and skin contact with liquid during cleaning and maintenance of ketone processing equipment, such as distillation columns, reactors, mixers, and storage vessels | A,B | Personal protective equipment (respiratory device, self-contained breathing apparatus or organic vapor mask -- upon conditions -- gloves and barrier creams) |

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