

Occupational Health Guideline for Heptane

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$
- Synonyms: Normal heptane
- Appearance and odor: Colorless liquid with a mild, gasoline-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for heptane is 500 parts of heptane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 2000 milligrams of heptane per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be reduced to 85 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 440 ppm averaged over a 15-minute period. The NIOSH Criteria Document for Alkanes should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Heptane can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

• Effects of overexposure

1. Short-term Exposure: Overexposure to heptane may cause a slight irritation of the eyes, nose, and throat, lightheadedness, hilarity, semi-consciousness, and dizziness. It may also cause loss of appetite and nausea. Higher concentrations may cause unconsciousness.

2. Long-term Exposure: Prolonged overexposure to the liquid may cause skin irritation.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to heptane.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to heptane at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the employee at increased risk, and to establish a baseline for future health monitoring. Examination of the central and peripheral nervous systems and the skin should be stressed.

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

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

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

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

2. Periodic Medical Examination: The aforementioned examinations should be performed on an annual basis.

• Summary of toxicology

Heptane vapor is a narcotic. Concentrations of 10,000 to 15,000 ppm produced narcosis in mice within 30 to 60 minutes, while 15,000 to 20,000 ppm caused convulsions

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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and death. At 48,000 ppm respiratory arrest was produced in mice in 3 to 4 minutes from the start of exposure. Human subjects exposed to 1000 ppm for 6 minutes, or to 2000 ppm for 4 minutes, reported slight vertigo. At 5000 ppm for 4 minutes, there was marked vertigo, inability to walk a straight line, hilarity, and incoordination, but no complaints of eye and upper respiratory tract or mucous membrane irritation. A 15-minute exposure at 5000 ppm produced in some subjects a state of stupor lasting for 30 minutes after exposure. These subjects also reported loss of appetite, slight nausea, and a taste resembling gasoline for several hours after exposure. The liquid is a defatting agent, and prolonged exposure may cause irritation of the skin. Aspiration may cause a chemical pneumonia. No chronic systemic effects have been reported in humans.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 100
2. Boiling point (760 mm Hg): 98.4 C (209 F)
3. Specific gravity (water = 1): 0.7
4. Vapor density (air = 1 at boiling point of heptane): 3.5
5. Melting point: -90.6 C (-132 F)
6. Vapor pressure at 20 C (68 F): 40 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.005
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

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

• Flammability

1. Flash point: -3.9 C (25 F) (closed cup)
2. Autoignition temperature: 215 C (419 F)
3. Flammable limits in air, % by volume: Lower: 1.05; Upper: 6.7
4. Extinguishant: Dry chemical, foam, carbon dioxide

• Warning properties

1. Odor Threshold: Summer reports an odor threshold of 220 ppm; May reports 50 and 220 ppm.
2. Eye Irritation Level: Heptane is not known to be an eye irritant.
3. Evaluation of Warning Properties: Since the odor threshold of heptane is well below the permissible exposure limit, heptane is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• Eight-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of heptane. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of heptane vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure heptane may be used. An analytical method for heptane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid heptane.
- Any clothing which becomes wet with liquid heptane should be removed immediately and not reworn until the heptane is removed from the clothing.
- Clothing wet with liquid heptane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of heptane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the heptane, the person performing the operation should be informed of heptane's hazardous properties.
- Employees should be provided with and required to use splash-proof safety goggles where liquid heptane may contact the eyes.
- Where there is any possibility that employees' eyes may be exposed to heptane, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes wet with liquid heptane should be promptly washed or showered with soap or mild detergent and water to remove any heptane.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to heptane may occur and control methods which may be effective in each case:

Operation	Controls
Use as a carrier and penetrant solvent for adhesives, use in azeotropic distillations, and in rubber tire manufacture; as a solvent in rubber cements	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as an ink solvent in gravure printing	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a solvent in polymer industry as a swelling and blowing agent for plastic foams	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Operation

Use as a reference fuel for testing gasoline engine knock and pollution and combustion studies

Use as a diluent solvent for lacquers during preparation and application

Use in organic chemical synthesis in preparations of toluene and alkylbenzenes

Use as an extraction solvent for tallow from meat, rosin from wood, and oils from seeds

Use in cleaning surfaces before application of adhesives

Use as a laboratory solvent for scientific testing

Controls

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EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If heptane gets into the eyes, wash 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.

• Skin Exposure

If heptane gets on the skin, promptly wash the contaminated skin using soap or mild detergent. If heptane soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of heptane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

If heptane has been swallowed, do not induce vomiting. Get medical attention immediately.

- **Rescue**

Move the 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. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

- If heptane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Heptane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- **Waste disposal method:**

Heptane may be disposed of by atomizing in a suitable combustion chamber.

REFERENCES

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RESPIRATORY PROTECTION FOR HEPTANE

Condition	Minimum Respiratory Protection* Required Above 500 ppm
Vapor Concentration	
850 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
4250 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 4250 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.