

# Occupational Health Guideline for Pentane

## 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:  $C_5H_{12}$
- Synonyms: Normal pentane
- Appearance and odor: Colorless liquid with a gasoline-like odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for pentane is 1000 parts of pentane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 2950 milligrams of pentane per cubic meter of air ( $mg/m^3$ ). NIOSH has recommended that the permissible exposure limit be reduced to 120 ppm ( $350 mg/m^3$ ) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 610 ppm ( $1,800 mg/m^3$ ) 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

Pentane 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 pentane may cause drowsiness and irritation of the eyes and nose. Greater exposure may cause unconsciousness and death.

**2. Long-term Exposure:** Prolonged overexposure may cause irritation of the skin.

**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 pentane.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to pentane 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: Pentane 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.

—Liver disease: Although pentane 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 pentane 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.

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

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

### • Summary of toxicology

Pentane vapor is a mild narcotic and mucous membrane irritant. Exposure to 90,000 to 120,000 ppm resulted in narcosis in animals in 5 to 6 minutes; 130,000 ppm was fatal, with respiratory arrest occurring within 5 minutes of the start of exposure. Pentane injected subcutaneous-

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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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ly in rats produced temporary impairment of liver function and moderate neutropenia. While other aliphatic hydrocarbons produce drowsiness and mild irritation of the eyes and nose in human subjects, no symptoms resulted from exposure to pentane vapor for 10 minutes at 5000 ppm. Repeated or prolonged skin contact results in drying and cracking due to defatting action. No chronic systemic effects have been reported in humans. Aspiration may cause chemical pneumonia.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 72.2
2. Boiling point (760 mm Hg): 36 C (97 F)
3. Specific gravity (water = 1): 0.63
4. Vapor density (air = 1 at boiling point of pentane): 2.5
5. Melting point: -129 C (-200 F)
6. Vapor pressure at 20 C (68 F): 426 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.04
8. Evaporation rate (butyl acetate = 1): 28.6

### • 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 pentane.
4. Special precautions: Pentane will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Flash point: -49 C (-57 F) (closed cup)
2. Autoignition temperature: 260 C (500 F)
3. Flammable limits in air, % by volume: Lower: 1.5; Upper: 7.8
4. Extinguishant: Foam, dry chemical, carbon dioxide

### • Warning properties

1. Odor Threshold: May reports an odor threshold of 2.2 ppm. The *Hygienic Guide* states that "the odor threshold of pentane vapor is approximately the same as the recommended maximal concentration of 1000 ppm."
2. Eye Irritation Level: Pentane is not a known eye irritant.
3. Evaluation of Warning Properties: Since its odor threshold is at or below the permissible exposure limit, pentane is treated as a material with adequate 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 pentane. 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 pentane 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 pentane may be used. An analytical method for pentane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

## 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 pentane.

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

## SANITATION

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

## COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as a gasoline additive for automotive, aviation, and farm equipment	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in synthesis of amyl chlorides for intermediates in manufacture of paint and lacquer solvents, tube oil additives, hydraulic fluids, pesticides, paint removers, solvent extenders, and miscellaneous petrochemicals; use in synthesis of polychlorocyclopentanes as intermediates in manufacture of fire-resistant polyester resins and paints, dye intermediates, insecticides, and plasticizers	Local exhaust ventilation; general dilution ventilation; personal protective equipment

## Operation

## Controls

Use as a blowing agent for polymeric foams	Local exhaust ventilation; general dilution ventilation
Use as a raw material in synthesis of olefins for synthetic rubber and other petrochemicals	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in solvent extraction processes; use as a general laboratory solvent; use as a medium solvent for polymerization reactions	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a component of lighter fluids and blow-torch fuel	Local exhaust ventilation; general dilution ventilation
Use as a heat-exchange medium in manufacture of artificial ice; use in manufacture of low-temperature thermometers; use in manufacture of polystyrene beads for styrofoam production	Local exhaust ventilation; general dilution ventilation; personal protective equipment

## 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 pentane 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 pentane gets on the skin, promptly wash the contaminated skin with water. If pentane soaks through the clothing, remove the clothing immediately and wash the skin with water. If irritation persists after washing, get medical attention.

### • Breathing

If a person breathes in large amounts of pentane, 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 pentane 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 pentane 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. Pentane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal method:

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

## **REFERENCES**

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## RESPIRATORY PROTECTION FOR PENTANE

Condition	Minimum Respiratory Protection* Required Above 1000 ppm
Vapor Concentration	
5000 ppm or less	A gas mask with a chin-style or front- or back-mounted organic vapor canister. Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 5000 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.