

Occupational Health Guideline for Cyclopentadiene

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_6
- Synonyms: 1,3-Cyclopentadiene
- Appearance and odor: Colorless liquid with a sweet odor like turpentine; dimer is a crystalline material with a camphor-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cyclopentadiene is 75 parts of cyclopentadiene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 200 milligrams of cyclopentadiene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- Routes of exposure
Cyclopentadiene might possibly affect the body if it is inhaled, is swallowed, or allowed to come in contact with the eyes or skin.
- Effects of overexposure
Overexposure to cyclopentadiene may cause irritation of the eyes and nose.
- 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 cyclopentadiene.
- Recommended medical surveillance
The following medical procedures should be made available to each employee who is exposed to cyclopentadiene at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from cyclopentadiene exposure.

—Liver disease: Although cyclopentadiene 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 cyclopentadiene 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 cyclopentadiene might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- Summary of toxicology
Cyclopentadiene vapor is irritating to the eyes and nose and has an objectionable odor. Repeated daily exposure of rats at 500 ppm produced mild toxic effects in the liver and kidneys, whereas repeated daily exposures in several species of animals at 250 ppm for 135 times produced no manifest effects. Dogs exposed to repeated daily exposures of up to 800 ppm had no ill effects; liver function and hematologic findings remained negative. Chronic systemic effects have not been reported in humans.

CHEMICAL AND PHYSICAL PROPERTIES

- Physical data
 1. Molecular weight: 66
 2. Boiling point (760 mm Hg): 41.5 C (107 F)
 3. Specific gravity (water = 1): 0.8
 4. Vapor density (air = 1 at boiling point of cyclo-

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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pentadiene): 2.3

5. Melting point: $-85\text{ C} (-121\text{ F})$

6. Vapor pressure at $20\text{ C} (68\text{ F})$: Data not available

7. Solubility in water, g/100 g water at $20\text{ C} (68\text{ F})$:

Insoluble

8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat. Cyclopentadiene is converted to the higher boiling dicyclopentadiene on storage even at $0\text{ C} (32\text{ F})$. The reaction may become violent at higher temperatures.

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 cyclopentadiene.

4. Special precautions: Cyclopentadiene should be stored at $-20\text{ to }0\text{ C} (-4\text{ F to }32\text{ F})$. When stored in bulk, the conversion to dicyclopentadiene may become violent if the temperature is allowed to rise above $0\text{ C} (32\text{ F})$.

• Flammability

1. Flash point: Less than $32\text{ C} (90\text{ F})$ (open cup) (flash point of dimer)

2. Autoignition temperature: $640\text{ C} (1184\text{ F})$

3. Flammable limits in air, % by volume: Data not available

4. Extinguishant: Dry chemical, carbon dioxide, foam

• Warning properties

1. Odor Threshold: According to the *Documentation of TLV's*, cyclopentadiene has "an irritating, terpene-like odor," but no quantitative information is available concerning its odor threshold.

The *Documentation of TLV's* states that "human sensory response was distinctly unfavorable at both 500 ppm and 250 ppm. Thus, although systemic injury is not to be expected from exposure concentrations averaging 250 ppm, a concentration significantly below 250 ppm is required from the standpoint of comfort. A TLV of 75 ppm is recommended."

2. Eye Irritation Level: Cyclopentadiene vapor is not specifically known to cause eye irritation. Grant states that "a less reactive cyclopentadiene-dimer formed by spontaneous polymerization has been tested on rabbit eyes and found to be only slightly injurious . . ."

3. Evaluation of Warning Properties: Through its sensory effects, cyclopentadiene can be detected at a concentration of about 3 times the permissible exposure limit. For the purposes of this guideline, therefore, cyclopentadiene is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

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).

• Method

An analytical method for cyclopentadiene 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 cyclopentadiene.

• Clothing wet with liquid cyclopentadiene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cyclopentadiene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyclopentadiene, the person performing the operation should be informed of cyclopentadiene's hazardous properties.

• Any clothing which becomes wet with liquid cyclopentadiene should be removed immediately and not reworn until the cyclopentadiene is removed from the

clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid cyclopentadiene may contact the eyes.

SANITATION

- Skin that becomes wet with liquid cyclopentadiene should be promptly washed or showered with soap or mild detergent and water to remove any cyclopentadiene.
- Employees who handle liquid cyclopentadiene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in thermal cracking of dicyclopentadiene; use in chemical synthesis	General dilution ventilation; personal protective equipment
Use in production of modified oil similar to tung oil from linseed or soybean oil	General dilution ventilation; personal protective equipment
Use in preparation of epoxy resins; preparation of ladder polymers; preparation of varnishes; use as a drying oil for varnishes	General dilution ventilation; personal protective equipment
Use in production of fire-resistant polyurethane foams; production of heat-stable, fire-resistant laminating agents and surface coatings; production of sanitary can coatings	General dilution ventilation; personal protective equipment
Use in production of foundry-core bindings; production of epoxidized olefins	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 cyclopentadiene gets into the eyes, wash eyes imme-

diately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If cyclopentadiene gets on the skin, promptly wash the contaminated skin using soap or mild detergent. If cyclopentadiene soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent.

• Breathing

If a person breathes in large amounts of cyclopentadiene, 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 cyclopentadiene 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 cyclopentadiene 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, allow the material to dimerize, collect on paper or other material. 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 may be reclaimed or dissolved in an appropriate solvent and atomized in a suitable combustion chamber. Cyclopentadiene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal method:

Cyclopentadiene may be disposed of by dissolving in an appropriate solvent and atomizing in a suitable combustion chamber.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Cyclopentadiene," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
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- Kirk, R., and Othmer, D.: *Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1968.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

RESPIRATORY PROTECTION FOR CYCLOPENTADIENE

Condition	Minimum Respiratory Protection* Required Above 75 ppm
Vapor Concentration	
750 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
2000 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 2000 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.