

Occupational Health Guideline for Chlorobenzene

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_6H_5Cl
- Synonyms: Monochlorobenzene; chlorobenzol; phenyl chloride; MCB
- Appearance and odor: Colorless liquid with a mild aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chlorobenzene is 75 parts of chlorobenzene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 350 milligrams of chlorobenzene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- Routes of exposure
Chlorobenzene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- Effects of overexposure
 1. *Short-term Exposure:* Chlorobenzene may cause drowsiness, incoordination, and unconsciousness. It may also cause irritation of the eyes, nose, and skin. Exposure to high levels might also cause liver damage.
 2. *Long-term Exposure:* Prolonged or repeated skin contact with chlorobenzene liquid may cause skin burns. Prolonged or repeated exposure to this chemical might also result in liver, kidney, or lung damage.
 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 chlorobenzene.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to chlorobenzene 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 chlorobenzene exposure.

—Skin disease: Chlorobenzene can cause dermatitis on exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Chlorobenzene is known as a liver toxin in animals. 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 chlorobenzene 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 chlorobenzene 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

Chlorobenzene vapor is a narcotic. Cats exposed to 8,000 ppm showed severe narcosis after ½ hour and died 2 hours after removal from exposure, but 660 ppm for 1 hour was tolerated. Exposed animals showed eye and nose irritation, drowsiness, incoordination, and coma followed by death from the most severe exposures. Several species of animals exposed to 1,000 ppm for 7 hours/day, 5 days/week over a period of 44 days showed histopathologic changes in the lungs, liver, and

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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kidneys, but at 475 ppm there was only slight liver histopathology in guinea pigs. Toxicologic studies and experience indicate that chlorobenzene does not cause the type of blood changes seen with benzene exposure. In man, eye and nasal irritation begin to occur at 200 ppm, and at that level the odor is pronounced and unpleasant; industrial experience indicates that occasional short exposures are not likely to result in more than minor skin irritation, but prolonged or frequently repeated contact may result in skin burns. In one case of accidental poisoning from ingestion of the liquid by a child there was pallor, cyanosis, and coma, followed by complete recovery. Occupational intoxication has not been reported.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 112.5
2. Boiling point (760 mm Hg): 132 C (270 F)
3. Specific gravity (water = 1): 1.1
4. Vapor density (air = 1 at boiling point of chlorobenzene): 3.9
5. Melting point: -44 C (-47 F)
6. Vapor pressure at 20 C (68 F): 8.8 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.05
8. Evaporation rate (butyl acetate = 1): 1

• Reactivity

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

• Flammability

1. Flash point: 28.9 C (84 F) (closed cup)
2. Autoignition temperature: 638 C (1180 F)
3. Flammable limits in air, % by volume: Lower: 1.3; Upper: 7.1
4. Extinguishant: Carbon dioxide; dry chemical, foam

• Warning properties

According to both Deichmann and Gerarde and the AIHA *Hygienic Guide*, the odor of chlorobenzene is "barely perceptible" at 60 ppm, a concentration below that of the permissible exposure. Chlorobenzene is considered to have good warning properties. It is an eye irritant, as stated by Patty, but the exact concentrations at which this irritation occurs are not mentioned.

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

Sampling and analyses may be performed by collection of 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 chlorobenzene may be used. An analytical method for chlorobenzene 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 chlorobenzene.

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

• Any clothing which becomes wet with liquid chlorobenzene should be removed immediately and not

reworn until the chlorobenzene is removed from the clothing.

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

SANITATION

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

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in manufacture of phenol in synthesis of polymeric materials	Local exhaust ventilation
Use as an intermediate in manufacture of ortho- and para-nitrobenzenes for use in dye manufacture; manufacture of DDT, aniline, picric acid, beta-chloroanthraquinone, and other chemicals; manufacture of rubber adhesives and adhesives	Process enclosure
Use as fiber swelling agent and dye carrier in textile processing	Local exhaust ventilation
Use as tar and grease remover in cleaning and degreasing operations	Local exhaust ventilation
Use as solvent in surface coatings and surface coating removers	Process enclosure; local exhaust ventilation; personal protective equipment
Use as extractant in manufacture of diisocyanates, rubber, perfumes, and pharmaceuticals	Local exhaust ventilation

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 chlorobenzene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and

upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

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

• Breathing

If a person breathes in large amounts of chlorobenzene, 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 chlorobenzene 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 chlorobenzene 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 reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Chlorobenzene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of chlorobenzene vapors are permitted.

• Waste disposal method:

Chlorobenzene may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

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RESPIRATORY PROTECTION FOR CHLOROBENZENE

Condition	Minimum Respiratory Protection* Required Above 75 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2400 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 2400 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.