

Occupational Health Guideline for Chlorodiphenyl (42% Chlorine)*

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: $C_{12}H_7Cl$, (approximately)
- Synonyms: Polychlorinated biphenyl; PCB
- Appearance and odor: Colorless to dark liquid with a mild hydrocarbon odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chlorodiphenyl (42% chlorine) is 1 milligram of chlorodiphenyl (42% chlorine) per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit for polychlorinated biphenyls be reduced to 1.0 microgram per cubic meter of air averaged over a work shift of up to 10 hours per day, 40 hours per week, and that chlorodiphenyl (42% chlorine) be regulated as an occupational carcinogen. The NIOSH Criteria Document for Polychlorinated Biphenyls should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- Routes of exposure
Chlorodiphenyl (42% chlorine) can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin. Every effort should be made to prevent skin, eye, oral, or inhalation contact with this material.
- Effects of overexposure
Chlorodiphenyl (42% chlorine) may cause irritation of the eyes, nose, and throat, and an acne-like skin rash. It

may also injure the liver, resulting in such effects as fatigue, dark urine, and yellow jaundice. Repeated skin contact with the liquid may cause skin irritation. The production of liver tumors and adverse reproductive effects has been demonstrated in experimental animals following ingestion of polychlorinated biphenyls. The relevance to humans of some of these studies has not yet been established.

• 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 chlorodiphenyl (42% chlorine).

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to chlorodiphenyl (42% chlorine) 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 exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver and skin should be stressed. The skin should be examined for evidence of chronic disorders. Women in the work force should be advised of the potential adverse effects of chlorodiphenyl (42% chlorine) on the unborn child. Those who have borne children and work with chlorodiphenyl (42% chlorine) should be counseled concerning the advisability of nursing their offspring.

—Liver function tests: Chlorodiphenyl (42% chlorine) may cause liver damage. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

—Skin disease: Chlorodiphenyl (42% chlorine) 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 this agent.

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

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

• Summary of toxicology

Chlorodiphenyl (42% chlorine) vapor is toxic to the liver and causes an acne-form dermatitis (chloracne). Guinea pigs died at intervals up to 21 days after the first of 11 daily applications of 34.5 mg to the skin and, at necropsy, the liver showed fatty degeneration and central atrophy; rats, however, survived 25 daily applications, and only slight changes in the liver were observed. The vapor and liquid are moderately irritating to eye tissues. Cases of mild to moderate skin irritation with an acne-form eruption have been reported in workers exposed to 0.1 mg/m³; levels of 10 mg/m³ were unbearably irritating. Several deaths due to atrophy of the liver have occurred among workers exposed to the fumes of chlorodiphenyls and chloronaphthalenes. The production of liver tumors and adverse reproductive effects has been demonstrated in experimental animals following ingestion of polychlorinated biphenyls. The relevance to humans of some of these studies has not yet been established.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 257.5 (approximately)
2. Boiling point (760 mm Hg): 325–366 C (617–691 F)
3. Specific gravity (water = 1): 1.38
4. Vapor density (air = 1 at boiling point of chlorodiphenyl (42% chlorine)): 8.9
5. Melting point: –19 C (-2 F) (pour point)
6. Vapor pressure at 20 C (68 F): 0.001 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Insoluble

8. Evaporation rate (butyl acetate = 1): Much less than 1

• 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 hydrogen chloride and carbon monoxide) may be released in a fire involving chlorodiphenyl (42% chlorine).
4. Special precautions: Chlorodiphenyl (42% chlorine) will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 176 C (349 F)
2. Autoignition temperature: None to boiling point
3. Flammable limits in air, % by volume: Not available
4. Extinguishant: Foam, dry chemical, carbon dioxide

• Warning properties

According to the AIHA *Hygienic Guide*, chlorodiphenyl (42% chlorine) has a typical aromatic odor and causes eye irritation. For the purposes of this guideline, however, it is treated as a material with poor warning

properties, as no quantitative data are available concerning its odor and irritation thresholds. As stated in the AIHA *Hygienic Guide*, the vapors of the chlorodiphenyls are “moderately irritating to eye tissues.” The concentrations causing eye irritation 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 chlorodiphenyl (42% chlorine) on a glass fiber filter connected in a series with a midjet bubbler containing iso-octane, followed by gas chromatographic analysis. A detailed analytical method for chlorodiphenyl (42% chlorine) may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161, under the title “NIOSH Analytical Methods for Set 2” (order number PB 271

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 any possibility of skin contact with liquid chlorodiphenyl (42% chlorine).

- Clothing contaminated with liquid chlorodiphenyl (42% chlorine) should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chlorodiphenyl (42% chlorine) from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chlorodiphenyl (42% chlorine), the person performing the operation should be informed of chlorodiphenyl's (42% chlorine) hazardous properties.

- Non-impervious clothing which becomes contaminated with liquid chlorodiphenyl (42% chlorine) should be removed promptly and not reworn until the chlorodiphenyl (42% chlorine) is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid chlorodiphenyl (42% chlorine) may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid chlorodiphenyl (42% chlorine) should be promptly washed or showered with soap or mild detergent and water to remove any chlorodiphenyl (42% chlorine).

- Eating and smoking should not be permitted in areas where liquid chlorodiphenyl (42% chlorine) is handled, processed, or stored.

- Employees who handle liquid chlorodiphenyl (42% chlorine) should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

- Areas in which exposure to chlorodiphenyl (42% chlorine) may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to chlorodiphenyl (42% chlorine) may occur and control methods which may be effective in each case:

Operation	Controls
Use as high-temperature transfer medium in chemical/food processing vessels and drying ovens	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a dielectric in manufacture of transformers, capacitors, resistors, and other electrical apparatus	General dilution ventilation; local exhaust ventilation; personal protective equipment

Operation	Controls
Application and formulation as plasticizer, flame-retardant, and adhesive and weatherizer in spray surface coatings; manufacture and application of impregnants for cloth, paper, fiberboard, wood, and asbestos; manufacture and application of natural and synthetic waxes and polishes; manufacture and application of hot-melt and other adhesives	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as non-flammable working fluid in vacuum pumps, hydraulic systems, and expansion systems	General dilution ventilation; local exhaust ventilation
Use during application of high-pressure, temperature, and moisture lubricants	Personal protective equipment
Use in compounding and processing of plastics for flame retardancy	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in manufacture and application for use as pesticides and fungicides	Personal protective equipment
Use as an intermediate or raw material in further organic synthesis	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as sealer for gaskets of natural rubber and synthetics	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as adhesive release on tapes and ink release on carbonless duplicating paper; as a pigment carrier in dyeing polyesters and paper	Personal protective equipment

Use as a pressure adhesive for sign backings, insect traps, and tapes

General dilution ventilation; local exhaust ventilation; personal protective equipment

Use in compounding mastics, and sealing and caulking materials; use in compounding of printing inks

General dilution ventilation; local exhaust 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 chlorodiphenyl (42% chlorine) 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 chlorodiphenyl (42% chlorine) gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If chlorodiphenyl (42% chlorine) soaks through the clothing, remove the clothing promptly 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 chlorodiphenyl (42% chlorine), 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

When chlorodiphenyl (42% chlorine) has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• 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 chlorodiphenyl (42% chlorine) is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Chlorodiphenyl (42% chlorine) may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

REFERENCES

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- Kirk, R., and Othmer, D.: *Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1968.
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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 7, 1974, and Volume 18, 1978.

RESPIRATORY PROTECTION FOR CHLORODIPHENYL (42% CHLORINE)

Condition	Minimum Respiratory Protection* Required Above 1 mg/m ³
Vapor Concentration	
10 mg/m ³ or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 10 mg/m ³ ** 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 pesticides. Any escape self-contained breathing apparatus.

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

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of chlorodiphenyl (42% chlorine); however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 10 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

