

# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIBROMOCHLOROPROPANE POTENTIAL HUMAN CARCINOGEN

## INTRODUCTION

This guideline summarizes pertinent information about dibromochloropropane (DBCP) for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

## SUBSTANCE IDENTIFICATION

- **Formula:** C<sub>3</sub>H<sub>3</sub>Br<sub>2</sub>Cl
- **Structure:** 
$$\begin{array}{c} \text{ClCH}_2\text{-CH-CH}_2\text{Br} \\ | \\ \text{Br} \end{array}$$

- **Synonyms:** 1-Chloro-2,3-dibromopropane; DBCP; 1,2-dibromo-3-chloropropane
- **Identifiers:** CAS 96-12-8; RTECS TX8750000; DOT 2872, label required: "St. Andrew's Cross (X)"
- **Appearance and odor:** Dense yellow or amber liquid or granular solid with a pungent odor

## CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 236.35
  2. Boiling point (at 760 mmHg): 195°C (383°F)
  3. Specific gravity (water = 1): 2.093
  4. Melting point: 6°C (43°F)
  5. Vapor pressure at 20°C (68°F): 0.8 mmHg
  6. Solubility in water, g/100 g water at 20°C (68°F): 0.1
  7. Saturation concentration in air (approximate) at 20°C (68°F): 0.1% (1000 ppm)
- **Reactivity**
  1. Incompatibilities: DBCP reacts with chemically active metals such as aluminum, magnesium, and tin alloys.
  2. Hazardous decomposition products: Toxic vapors and gases (e.g., hydrogen bromide, hydrogen chloride, and carbon monoxide) may be released in a fire involving DBCP.

3. Caution: DBCP will attack some rubber materials and coatings.

- **Flammability**

1. Flash point: 77°C (170°F) (open cup)
2. Extinguishant: Carbon dioxide or dry chemical
3. Class IIIA Combustible Liquid (29 CFR 1910.106)

- **Warning properties**

1. Odor threshold: 0.01-0.03 ppm
2. Evaluation of warning properties for respirator selection: Because of the lack of odor at concentrations below the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL), DBCP is treated as a chemical with poor warning properties.

## EXPOSURE LIMITS

The Occupational Safety and Health Administration (OSHA) considers DBCP to be a cancer hazard. The current OSHA permissible exposure limit (PEL) for DBCP is 1 part of DBCP per billion parts of air (ppb) as a time-weighted average (TWA) concentration over an 8-hour workshift; the employer shall assure that no employee is exposed to eye or skin contact with DBCP. The NIOSH REL is 10 ppb as a TWA [0.1 milligrams of DBCP per cubic meter of air (mg/m<sup>3</sup>)] for up to a 10-hour workshift, 40-hour workweek; however, the NIOSH REL has been superseded by the OSHA standard promulgated in 1978. The American Conference of Governmental Industrial Hygienists (ACGIH) does not have an assigned threshold limit value (TLV<sup>®</sup>) for DBCP.

## HEALTH HAZARD INFORMATION

- **Routes of exposure**

DBCP may cause adverse health effects following exposure via inhalation or dermal or eye contact.

- **Summary of toxicology**

1. *Effects on animals:* In rats, acute inhalation or oral administration of DBCP caused central nervous system depression with sluggishness and loss of muscular coordination (ataxia), weight loss, and decreased spermatogenesis; acute dermal exposure caused dermal and subcutaneous tissue destruction (necrosis).

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Division of Standards Development and Technology Transfer

Subchronic inhalation of DBCP by rats, guinea pigs, rabbits, or monkeys produced necrosis of the liver, kidney, spleen, testes, or seminiferous tubules; reduction in sperm count; abnormal sperm; or inhibition of the estrous cycle. Cancers of the nasal cavity, tongue, pharynx, lungs, stomach, adrenal glands, or mammary glands have been reported for rats or mice chronically exposed to DBCP by inhalation or oral administration.

2. *Effects on humans:* Low-level repeated or prolonged exposure of male workers has been associated with low sperm count, chromosome abnormality, sterility, decreased testicular size, and increased level of follicle stimulating hormone. These effects have not been associated with exposure in previous years, indicating that they may be reversible following removal from exposure.

- **Signs and symptoms of exposure**

1. *Short-term (acute):* Exposure to DBCP can cause drowsiness, nausea, vomiting, and irritation of the eyes, nose, throat and skin.

2. *Long-term (chronic):* Exposure to DBCP can cause congestion or fluid in the lungs and inflammation of the eyes or skin.

## RECOMMENDED MEDICAL PRACTICES

- **Medical surveillance program**

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

- **Preplacement medical evaluation**

Prior to placing a worker in a job with a potential for exposure to DBCP, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and

physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, liver, kidneys, urinary tract, and reproductive and respiratory systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to DBCP at or below the NIOSH REL. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include a history of chronic skin disease or concurrent dermatitis and a history of reproductive dysfunction. In addition to the medical interview and physical examination, the means to identify these conditions may include an evaluation of fertility.

- **Periodic medical screening and/or biologic monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to DBCP. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the physiologic function and integrity of the eyes, skin, liver, kidneys, urinary tract, and respiratory and reproductive systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population. The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and ATS: standardized questionnaires and tests of lung function.

- **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to DBCP may cause adverse reproductive effects and diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

- **Sentinel health events**

1. Acute SHE's include: Contact and/or allergic dermatitis.
2. Delayed-onset or reproductive SHE's include: Infertility in exposed males.

## MONITORING AND MEASUREMENT PROCEDURES

- **TWA exposure evaluation**

Measurements to determine worker exposure to DBCP should be taken so that the TWA exposure is based on a single entire

workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

**• Method**

There are no NIOSH validated sampling and analytical methods for DBCP.

**PERSONAL PROTECTIVE EQUIPMENT**

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, face shields (8-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with DBCP.

Workers should be provided with and required to use dust- and splash-proof safety goggles where DBCP or other dust may come in contact with the eyes.

**SANITATION**

Clothing which is contaminated with DBCP should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of DBCP from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of DBCP's hazardous properties.

Change and shower rooms should be provided with separate locker facilities for street and work clothes.

Skin that becomes contaminated with DBCP should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle DBCP should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

**COMMON OPERATIONS AND CONTROLS**

Common operations in which exposure to DBCP may occur and control methods which may be effective in each case are listed in Table 1.

**Table 1.—Operations and methods of control for dibromochloropropane**

Operations	Controls
During the manufacture of DBCP	Completely enclosed processes, local exhaust ventilation, personal protective equipment
During the formulation of DBCP into pesticides and fumigants	Local exhaust ventilation, protective clothing and equipment

**EMERGENCY FIRST AID PROCEDURES**

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

**• Eye exposure**

Where there is any possibility of a worker's eyes being exposed to DBCP, an eye-wash fountain should be provided within the immediate work area for emergency use.

If DBCP gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

**• Skin exposure**

Where there is any possibility of a worker's body being exposed to DBCP, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If DBCP gets on the skin, wash it immediately with soap and water. If DBCP penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

**• Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. 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.

**SPILLS AND LEAKS**

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

If DBCP 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 of liquids containing DBCP, absorb on paper towels and place in an appropriate container. Place towels

in a safe place such as a fume hood for evaporation. Allow sufficient time for evaporation of the vapors so that the hood ductwork is free from DBCP vapors. Burn the paper in a suitable location away from combustible materials.

4. Large quantities of liquids containing DBCP may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container. DBCP should not be allowed to enter a confined space such as a sewer because of the possibility of an explosion.

5. DBCP liquid or solid may be collected by vacuuming with an appropriate system. If a vacuum system is used, there should be no sources of ignition in the vicinity of the spill and flashback prevention devices should be provided.

## WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

## RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure: when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations, including those requiring confined-space entry (Table 2).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards, 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

For each level of respiratory protection only those respirators that have the minimum required protection factor and meet other use restrictions are listed. All respirators that have higher protection factors may also be used.

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**Table 2.—Respiratory protection for dibromochloropropane**

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode  Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode  Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister having a high-efficiency particulate filter  Any appropriate escape-type self-contained breathing apparatus

\* Only NIOSH/MSHA-approved equipment should be used.

