

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DICHLOROACETYLENE

INTRODUCTION

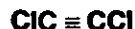
This guideline summarizes pertinent information about dichloroacetylene for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

• Formula



• Structure



• Synonyms

Dichloroethyne; 1,2-dichloroacetylene

• Identifiers

1. CAS No.: 7572-29-4
2. RTECS No.: AP1080000
3. DOT UN: May not be transported.
4. DOT label: Forbidden

• Appearance and odor

Dichloroacetylene is a combustible, volatile, self-reactive liquid with an isocyanide-like odor. This material is not produced or used commercially; it is an undesirable byproduct of the dehydrochlorination or incomplete incineration of trichloroethylene.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 94.9
2. Boiling point (760 mm Hg): Explodes on boiling at 32° to 33°C (90° to 91°F)
3. Specific gravity: Data not available
4. Vapor density: Data not available
5. Melting point: -66° to -64.2°C (-86.8° to -83.6°F)
6. Vapor pressure at 20°C (68°F): Data not available
7. Solubility: Insoluble in water; soluble in alcohol, ethanol, and acetone
8. Evaporation rate: Data not available

• Reactivity

1. Conditions contributing to instability: shock, heat, sparks, open flame, acids, oxidizing materials, or contact with the air.

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Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Education and Information Division

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Occupational Safety and Health Administration

2. **Incompatibilities:** Contact of dichloroacetylene with air causes autoxidation and may cause an explosion; contact with acids or oxidizing materials also may cause a violent reaction.
3. **Hazardous decomposition products:** Toxic gases (such as carbon dioxide, phosgene, and chlorine) may be released in a fire involving dichloroacetylene.
4. **Special precautions:** Dichloroacetylene explodes or ignites on contact with air and explodes if it reaches boiling temperature. Also, in air, unstabilized dichloroacetylene decomposes to phosgene, chloroform, carbon tetrachloride, trichloroacryloyl chloride, and hexachlorobutadiene.

Flammability

The National Fire Protection Association has not assigned a fire hazard rating to dichloroacetylene. However, this substance is known to be spontaneously combustible and to pose a severe explosion hazard when exposed to heat or shock.

1. **Flash point:** Spontaneously combustible
2. **Autoignition temperature:** Data not available
3. **Flammable limits in air:** Data not available
4. **Extinguishant:** Use carbon dioxide, water spray, or regular foam. Do not use any chemical extinguishants because dichloroacetylene is shock-sensitive and contact with the surface of dry chemicals may increase its explosive potential. Do not use more water than is necessary to extinguish the fire because it will scatter the fire.

Fires involving dichloroacetylene should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving dichloroacetylene because poisonous gases (such as phosgene and hydrogen chloride) may be produced in a fire.

EXPOSURE LIMITS

OSHA PEL

The Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure

limit (PEL) for dichloroacetylene [29 CFR 1910.1000, Table Z-1].

• NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 0.1 ppm (0.4 mg/m³) as a ceiling limit. A worker's exposure to dichloroacetylene shall at no time exceed this ceiling level [NIOSH 1992].

• ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned dichloroacetylene a ceiling limit value of 0.1 ppm (0.9 mg/m³), which should not be exceeded during any part of the working day [ACGIH 1993].

• Rationale for limits

The NIOSH limit is based on the potential for cancer, neurotoxicity, and CNS depression and also the formation of kidney tumors in animals associated with dichloroacetylene exposure. The ACGIH limit is based on the risk of nausea and other systemic effects associated with exposure to dichloroacetylene.

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to dichloroacetylene can occur through inhalation and eye or skin contact.

• Summary of toxicology

1. **Effects on Animals:** Dichloroacetylene causes kidney and liver damage and cancer in experimental animals. In mice, a 1-hr LC₅₀ of 124 ppm and a 4-hr LC₅₀ of 19 ppm have been reported. The cause of death was kidney injury [Clayton and Clayton 1981]. A 6-hr LC₅₀ in mice of 19 ppm has also been reported [RTECS 1991]. Exposure to dichloroacetylene concentrations of 126, 202, or 307 ppm for 1 hour or to 17 to 23 ppm for 6 hours caused neuropathological changes, kidney and liver damage, and death among rabbits [Clayton and Clayton 1981; IARC 1986]. Rats exposed continuously to a 2.8-ppm concentration of dichloroacetylene for 90 days became emaciated and showed hind limb weakness and kidney injury, and one animal became blind [Grant 1986]. Rats exposed for 6 hours/day, 5 days/week for 6

weeks to a 9.8-ppm concentration of dichloroacetylene (along with 50-ppm trichloroacetylene) or to 15.5 ppm dichloroacetylene (along with 150 ppm trichloroacetylene) were unkempt in appearance and showed signs of respiratory distress; rats in the 15.5-ppm group also showed marked kidney injury at autopsy [Clayton and Clayton 1981]. Dichloroacetylene has been tested for carcinogenicity in inhalation bioassays in mice and rats. Male mice showed dose-related increases in the incidence of adenocarcinomas of the kidney, and rats of both sexes showed an increased incidence of lymphomas and also developed benign tumors of the liver and kidney [IARC 1986]. Based on these data, the International Agency for Research on Cancer has concluded that there is limited evidence that dichloroacetylene is carcinogenic in animals [IARC 1986].

2. *Effects on Humans:* In humans, dichloroacetylene causes eye irritation, headache, nausea, and vomiting as well as nervous system injury and death. As a neurotoxin, dichloroacetylene has an affinity for the cranial nerves [IARC 1986]. Exposure to a 0.5- to 1-ppm concentration of dichloroacetylene for prolonged (not further specified) periods caused nausea in 85 percent of exposed individuals [ACGIH 1991]. Members of a submarine crew developed loss of appetite, nausea that progressed to vomiting, itching around the eyes, headache, sore gums, intense pain in the upper jaw, and facial and oral herpes 3 to 4 days after exposure to dichloroacetylene [IARC 1986]. Tank car cleaners developed fatigue, headache, nausea, and vomiting; these workers also experienced a loss of sensation in the trigeminal nerve distribution that persisted for periods ranging from several days to years [IARC 1986]. Thirteen cases of dichloroacetylene-induced cranial nerve palsy and nine cases of herpes were reported in the 1940s. One patient died 3 days after exposure and a second died 13 days later; autopsy revealed cerebral edema in both of these cases [ACGIH 1991].

• **Signs and symptoms of exposure**

1. *Acute exposure:* The signs and symptoms of acute exposure to dichloroacetylene include redness, inflammation, and itching of the eyes and eyelids, weakness of the eye muscles, headache, nausea, vomiting, sore gums, painful jaws, loss of sensation in the lips and mucous membranes, fatigue, and facial and oral herpes characterized by painful blisters around the mouth.

2. *Chronic exposure:* Based on effects seen in animals, chronic exposure to dichloroacetylene may cause liver or kidney damage, with jaundice, enlarged and tender liver, and pus, protein, or blood in the urine.

• **Emergency procedures**

WARNING!
Exposed victims may die!
Transport immediately to emergency medical facility!

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Irritation may result from exposure to concentrated solutions, vapors, mists, or aerosols of dichloroacetylene. **Immediately and thoroughly** flush eyes with large amounts of water, occasionally lifting the upper and lower eyelids.
2. *Skin exposure:* Irritation may result. **Immediately** remove contaminated clothing and **thoroughly** wash contaminated skin with soap and water.
3. *Inhalation exposure:* Move the victim to fresh air **immediately**.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure:* Take the following steps if dichloroacetylene or any material containing it is ingested:

- Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.
- Have the victim drink a glass (8 oz) of fluid such as water.
- Induce vomiting by giving syrup of ipecac as directed on the package. If ipecac is unavailable, have the victim touch the back of the throat with a finger until productive vomiting ceases.

—Do *not* force an unconscious or convulsing person to drink fluid or to vomit.

5. *Rescue*: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may evolve dichloroacetylene and lead to worker exposures to this substance:

- Thermal dehydrochlorination of trichloroethylene
- Degradation of trichloroethylene, vinylidene chloride, or other hydrocarbons by pyrolysis at temperatures above 70°C (158°F), photolysis, or contact with alkaline materials
- Exposure of trichloroethylene vapors to Hopcalite in a closed environment or to soda lime in closed-circuit anesthesia machines
- Exposure of trichloroethylene liquid to a caustic substance in degreaser tanks

The following methods are effective in controlling worker exposures to dichloroacetylene, depending on the feasibility of implementation:

- Process enclosure
- Local exhaust ventilation
- General dilution ventilation
- Personal protective equipment

Good sources of information on control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. *Engineering design for control of workplace hazards*. New York, NY: McGraw-Hill.
5. Plog BA [1988]. *Fundamentals of industrial hygiene*. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease 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 monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

• Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to dichloroacetylene, a licensed health care professional 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 liver, kidneys, and sensory nerves.

A preplacement medical evaluation is recommended to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to dichloroacetylene at or below the prescribed exposure limit. The health care professional should consider the probable frequency, intensity, and duration of

exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the liver, kidneys, or sensory nerves.

- **Periodic medical examinations and biological monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to dichloroacetylene exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of dichloroacetylene on the liver, kidneys, or sensory nerves. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for dichloroacetylene.

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

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

A worker's exposure to airborne dichloroacetylene is determined using a solid sorbent (charcoal) tube (100/50 mg sections, 20/40 mesh). Samples are collected at a maximum flow rate of 0.2 liter/min until a maximum air vol-

ume of 1 liter is collected. The sample is then treated with carbon disulfide to extract the dichloroacetylene. Analysis is conducted by gas chromatography using a flame ionization detector. This method is described in the OSHA Laboratory In-House Methods File [OSHA 1991].

PERSONAL HYGIENE

If dichloroacetylene contacts the skin, workers should immediately wash the affected areas with soap and water.

Clothing contaminated with dichloroacetylene should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of dichloroacetylene.

A worker who handles dichloroacetylene should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, or applying cosmetics.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where dichloroacetylene is handled, processed, or stored.

STORAGE

Dichloroacetylene should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Storage areas must be equipped with explosion-proof electrical equipment and fittings. Containers of dichloroacetylene should be protected from physical damage and should be stored separately from strong acids, oxidizers, potassium, sodium, aluminum powder, heat, sparks, and open flame. Only nonsparking tools may be used to handle dichloroacetylene. An automatic pump should be used to transfer liquid dichloroacetylene from drums or storage containers to process containers. To prevent static sparks, containers should be grounded and bonded for transfers. Because containers that formerly contained dichloroacetylene may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving dichloroacetylene, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup

has been completed. The following steps should be undertaken following a spill or leak:

1. Notify safety personnel.
2. Isolate the area of the spill or leak.
3. Remove all sources of heat and ignition.
4. If possible to do so without risk, attempt to stop the leak.
5. Ventilate the area of the spill or leak.
6. For small liquid spills, absorb with earth, sand, vermiculite, or other absorbent material and place into closed containers for later disposal.
7. For large liquid spills, build dikes to contain the spill.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

• Emergency planning requirements

Dichloroacetylene is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

• Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of dichloroacetylene; there is no reportable quantity for this substance.

• Community right-to-know requirements

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of dichloroacetylene emitted or released from their facility annually.

• Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Although dichloroacetylene is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

• Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of dichloroacetylene exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

• Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1901.134]. Such a program must include respi-

rator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information about the selection and use of respirators and about the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective gloves, boots, aprons, and gauntlets should be worn as necessary to prevent prolonged or repeated skin contact with dichloroacetylene. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. No reports have been published on the resistance of various protective clothing materials to dichloroacetylene permeation. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to dichloroacetylene.

If dichloroacetylene is dissolved in an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or face shields should be worn during operations in which dichloroacetylene might contact the eyes. Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with dichloroacetylene. Contact lenses should not be worn when the potential for exposure to dichloroacetylene exists.

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