

# Occupational Health Guideline for 1,1,2,2-Tetrachloroethane

## 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:  $\text{CHCl}_2\text{CHCl}_2$
- Synonyms: Symmetrical-tetrachloroethane; acetylene tetrachloride; sym-tetrachlorethane
- Appearance and odor: Colorless or pale yellow liquid with a sickly sweet odor, like chloroform.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,1,2,2-tetrachloroethane is 5 parts of 1,1,2,2-tetrachloroethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 35 milligrams of 1,1,2,2-tetrachloroethane per cubic meter of air ( $\text{mg}/\text{m}^3$ ). NIOSH has recommended that the permissible exposure limit be reduced to 1 ppm ( $6.87 \text{ mg}/\text{m}^3$ ) averaged over a 10-hour work shift. The NIOSH Criteria Document for 1,1,2,2-Tetrachloroethane should be consulted for more detailed information.

## HEALTH HAZARD INFORMATION

- **Routes of exposure**  
1,1,2,2-Tetrachloroethane 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.
- **Effects of overexposure**
  1. **Short-term Exposure:** Breathing in high concentrations of 1,1,2,2-tetrachloroethane may cause irritation of the eyes and nose, nausea, vomiting, and drowsiness. Liver and kidney damage may occur. If the exposure was severe, within a few hours a deep dusky coloration

of the skin may appear, followed by unconsciousness and death. If the exposed worker is removed immediately, he may recover completely but should be placed under observation in case late symptoms appear. If the vapor or liquid of 1,1,2,2-tetrachloroethane gets into the eyes, it may cause watering and burning. It may cause serious eye damage unless immediate medical care is obtained.

2. **Long-term Exposure:** Prolonged or repeated exposure to 1,1,2,2-tetrachloroethane, either by breathing or by absorbing it through the skin, may cause fatigue, loss of appetite, tremors, weight loss, constipation, heart damage, blood changes, kidney damage, abdominal distress or pain, vomiting, dizziness, tenderness, liver damage with such symptoms as pain over the liver, dark urine, and yellow jaundice. Reproductive abnormalities have been noted in studies of animals following exposure to high levels of 1,1,2,2-tetrachloroethane. Prolonged or repeated skin contact with 1,1,2,2-tetrachloroethane may also cause skin irritation.

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 1,1,2,2-tetrachloroethane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 1,1,2,2-tetrachloroethane 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, kidneys, and central nervous system should be stressed.

—Liver function tests: 1,1,2,2-Tetrachloroethane causes liver damage. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

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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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Occupational Safety and Health Administration

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

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

• **Summary of toxicology**

1,1,2,2-Tetrachloroethane is highly toxic to the liver and is a central nervous system depressant. Rats exposed to 500 ppm for 4 hours survived, but 1,000 ppm was fatal. Reports of industrial experience indicate that cases of mild intoxication have presented symptoms of gastrointestinal irritation (nausea, vomiting, abdominal pain, anorexia) and central nervous system effects (dizziness, headache, irritability, nervousness, insomnia); more severe exposure resulted in liver involvement (enlarged and tender liver, jaundice, bilirubinuria), nephritis (albuminuria and casts); and tremors of hands and eyelids. In cases of severe industrial intoxication, there was hepatic necrosis with jaundice, sometimes progressing to cirrhosis; individuals who died during the acute stage also showed cerebral edema and pulmonary edema with hemorrhage, as well as liver and kidney injury. One study reported that human subjects exposed to 335 ppm for 10 minutes or 186 ppm for 30 minutes noted a disagreeable odor; there were some upper respiratory irritation and central nervous system effects. Among a group of workers in India exposed to 20-65 ppm there was nausea, vomiting, and abdominal pain and a high incidence of tremor of the hands. Prolonged skin exposure may be expected to produce dermatitis due to defatting action. Eye damage has been reported.

## CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 167.8
2. Boiling point (760 mm Hg): 146 C (295 F)
3. Specific gravity (water = 1): 1.6
4. Vapor density (air = 1 at boiling point of 1,1,2,2-tetrachloroethane): 5.8
5. Melting point: -42.5 C (-44.5 F)
6. Vapor pressure at 20 C (68 F): 8 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.29
8. Evaporation rate (butyl acetate = 1): 0.65

• **Reactivity**

1. Conditions contributing to instability: Heat; unusual exposure to light in the presence of air may form small amounts of phosgene.

2. Incompatibilities: Reacts with chemically active metals or with strong caustics. In the presence of steam, contact with hot iron, aluminum, and zinc may cause formation of toxic vapors.

3. Hazardous decomposition products: Toxic gases and vapors (such as phosgene, hydrogen chloride, chlorinated solvents, and carbon monoxide) may be

released when 1,1,2,2-tetrachloroethane decomposes.

4. Special precautions: Liquid 1,1,2,2-tetrachloroethane will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Not combustible

• **Warning properties**

Patty states that the odor of 1,1,2,2-tetrachloroethane is detectable at 5 ppm (3 ppm, according to Lehmann). Since the odor threshold is at (or below) the permissible exposure limit, this compound is treated as a material with good warning properties.

Grant indicates that this compound is not an eye irritant.

## 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 1,1,2,2-tetrachloroethane may be used. An analytical method for 1,1,2,2-tetrachloroethane 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). PB 265 028).

## 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 1,1,2,2-tetrachloroethane.
- Clothing contaminated with liquid 1,1,2,2-tetrachloroethane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 1,1,2,2-tetrachloroethane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 1,1,2,2-tetrachloroethane, the person performing the operation should be informed of 1,1,2,2-tetrachloroethane's hazardous properties.
- Where exposure of an employee's body to liquid 1,1,2,2-tetrachloroethane may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with liquid 1,1,2,2-tetrachloroethane should be removed immediately and not reworn until the 1,1,2,2-tetrachloroethane is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid 1,1,2,2-tetrachloroethane contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid 1,1,2,2-tetrachloroethane, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with liquid 1,1,2,2-tetrachloroethane should be immediately washed or showered with soap or mild detergent and water to remove any 1,1,2,2-tetrachloroethane.
- Eating and smoking should not be permitted in areas where liquid 1,1,2,2-tetrachloroethane is handled, processed, or stored.
- Employees who handle liquid 1,1,2,2-tetrachloroethane 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 1,1,2,2-tetrachloroethane may occur and control methods which may be effective in each case:

### Operation

### Controls

Use as a chemical intermediate in manufacture of tetrachloroethylene and trichloroethylene; use in cleaning and extraction processes; use in chlorination of phthalic anhydride; use in manufacture of cyanogen chloride, polymers, and tetrachloro-alkylphenol	Local exhaust ventilation; general dilution ventilation
Use as a fumigant in greenhouses	Personal protective equipment
Use in manufacture of lacquers and varnishes, paint and varnish removers	Process enclosure; local exhaust ventilation; personal protective equipment
Liberation during use and preparation of insecticides and weed killers	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in cleaning and degreasing of metals	Process enclosure; local exhaust ventilation; personal protective equipment
Use as a solvent in preparation of adhesives	Local exhaust ventilation
Use during addition to aliphatic alcohols and acetates to improve solvency for nitrocellulose and cellulose acetate as in photographic film	Local exhaust ventilation
Use in application of adhesives	General dilution ventilation; personal protective equipment
Use in refining of waxes and resins	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 1,1,2,2-tetrachloroethane 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 1,1,2,2-tetrachloroethane gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If 1,1,2,2-tetrachloroethane 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 1,1,2,2-tetrachloroethane, 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 1,1,2,2-tetrachloroethane 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 1,1,2,2-tetrachloroethane is spilled or leaked, the following steps should be taken:

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

- **Waste disposal method:**

1,1,2,2-Tetrachloroethane may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

## ADDITIONAL INFORMATION

To find additional information on 1,1,2,2-tetrachloroethane, look up 1,1,2,2-tetrachloroethane in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards
- NIOSH Criteria Document for 1,1,2,2-Tetrachloroethane (December 1976)

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

## REFERENCES

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## RESPIRATORY PROTECTION FOR 1,1,2,2-TETRACHLOROETHANE

Condition	Minimum Respiratory Protection* Required Above 5 ppm
Vapor Concentration	
50 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
150 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). 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 150 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.

