

Occupational Health Guideline for 1,1,2-Trichloro-1,2,2-Trifluoroethane

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: $CCl_2F-CClF_2$
- Synonyms: Halocarbon 113; Refrigerant 113; TTE
- Appearance and odor: Colorless liquid with an odor like carbon tetrachloride (at high concentrations).

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,1,2-trichloro-1,2,2-trifluoroethane is 1000 parts of 1,1,2-trichloro-1,2,2-trifluoroethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 7600 milligrams of 1,1,2-trichloro-1,2,2-trifluoroethane per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**
1,1,2-Trichloro-1,2,2-trifluoroethane 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:** 1,1,2-Trichloro-1,2,2-trifluoroethane may cause irritation of the eyes and throat or drowsiness. Breathing high concentrations may cause the heart to beat irregularly or to stop.
 2. **Long-term Exposure:** 1,1,2-Trichloro-1,2,2-trifluoroethane on prolonged or repeated contact with the skin may 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-trichloro-1,2,2-trifluoroethane.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to 1,1,2-trichloro-1,2,2-trifluoroethane 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 1,1,2-trichloro-1,2,2-trifluoroethane exposure.

—**Skin disease:** 1,1,2-Trichloro-1,2,2-trifluoroethane 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.

—**Cardiovascular disease:** In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the breathing of 1,1,2-trichloro-1,2,2-trifluoroethane might cause exacerbation of symptoms due to its sensitizing properties.

2. **Periodic Medical Examination:** Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

1,1,2-Trichloro-1,2,2-trifluoroethane vapor is a narcotic. In guinea pigs exposed to 25,000 ppm, nasal irritation was rapidly apparent and incoordination occurred at 50,000 ppm after 30 minutes; death occurred after one hour at this level. In dogs, cardiac sensitization to epinephrine occurred at concentrations of 5,000 to 10,000 ppm. The liquid produced no irritation on the abraded or intact skin of guinea pigs; in the eyes of rabbits it produced mild conjunctivitis and minimal corneal dullness, which were reversible. In experimental human studies, exposure to 4,500 ppm for 30 to 100 minutes resulted in significant impairment in tests of manual dexterity and vigilance; subjects reported loss of concentration and a tendency to somnolence which disappeared 15 minutes after the exposure ended; at

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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1,500 ppm no effects were observed. More prolonged human exposures of 6 hours daily, 5 days per week for 2 weeks at concentrations of approximately 500 and 1,000 ppm resulted in no adverse effects, with the exception of mild throat irritation on the first day; there was no decrement in performance of complex mental tasks. The liquid dissolves the natural oils of the skin, and dermatitis may occur as a result of repeated contact.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 187.4
2. Boiling point (760 mm Hg): 47.6 C (117.6 F)
3. Specific gravity (water = 1): 1.55
4. Vapor density (air = 1 at boiling point of 1,1,2-trichloro-1,2,2-trifluoroethane): 6.5
5. Melting point: -35 C (-31 F)
6. Vapor pressure at 20 C (68 F): 284 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.017
8. Evaporation rate (butyl acetate = 1): Greater than 1

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Reacts with chemically active metals such as calcium, powdered aluminum, zinc, magnesium and beryllium. Contact with magnesium alloys containing more than 2% magnesium may cause decomposition.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, hydrogen fluoride, phosgene, and carbon monoxide) may be released when 1,1,2-trichloro-1,2,2-trifluoroethane decomposes.
4. Special precautions: 1,1,2-Trichloro-1,2,2-trifluoroethane will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Not combustible

• Warning properties

Since the AIHA *Hygienic Guide* states that this compound is "nearly odorless," and since experimental evidence indicates that its irritant effects are only slight and transient at concentrations near the permissible exposure, it is treated as a material with poor warning properties.

There is no evidence to indicate that the vapor is an eye irritant. The *Documentation of TLV's* states that "no corneal injury or irritation" was observed in guinea pigs exposed to this substance. For the purposes of this guideline, therefore, it is not treated as 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-trichloro-1,2,2-trifluoroethane may be used. An analytical method for 1,1,2-trichloro-1,2,2-trifluoroethane 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). (order number 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 repeated or prolonged skin contact with liquid 1,1,2-trichloro-1,2,2-trifluoroethane.
- Non-impervious clothing which becomes wet with liquid 1,1,2-trichloro-1,2,2-trifluoroethane should be removed promptly and not reworn until the 1,1,2-trichloro-1,2,2-trifluoroethane 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-trichloro-1,2,2-trifluoroethane contacting the eyes.

SANITATION

• Skin that becomes wet with liquid 1,1,2-trichloro-1,2,2-trifluoroethane should be promptly washed or showered with soap or mild detergent and water to remove any 1,1,2-trichloro-1,2,2-trifluoroethane.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,1,2-trichloro-1,2,2-trifluoroethane may occur and control methods which may be effective in each case:

Operation	Controls
Use as a selective solvent in degreasing electrical equipment, photographic films, magnetic tapes, precision instruments, plastics, glass, elastomers, or metal components; as dry cleaning solvent for all fabrics, leather, and suedes.	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a refrigerant in commercial/industrial air conditioning and industrial process cooling	General dilution ventilation
Use as a chemical intermediate for dechlorination of chemicals in the manufacture of polymers, and copolymers in production of high-temperature lubricants	Process enclosure; local exhaust ventilation; general dilution ventilation
Use as a foaming or blowing agent in the manufacture of polymers for flame retardancy	Process enclosure; local exhaust ventilation; general dilution ventilation
Use as a solvent in the textile industry; and as a solvent in special laboratory usage	Local exhaust ventilation; general dilution 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 1,1,2-trichloro-1,2,2-trifluoroethane 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-trichloro-1,2,2-trifluoroethane gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If 1,1,2-trichloro-1,2,2-trifluoroethane 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-trichloro-1,2,2-trifluoroethane, 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-trichloro-1,2,2-trifluoroethane 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-trichloro-1,2,2-trifluoroethane 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-Trichloro-1,2,2-trifluoroethane may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "1,1,2-Trichloro-1,2,2-Trifluoroethane," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
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- E. I. DuPont de Nemours and Company: *Freon Compounds and Safety - 1,1,2-Trichloro-1,2,2-Trifluoroethane*, Wilmington, Delaware.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
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- Stopps, G. J., and McLaughlin, M.: "Psychophysiological Testing of Human Subjects Exposed to Solvent Vapors," *American Industrial Hygiene Association Journal*, 28:43-50, 1967.

RESPIRATORY PROTECTION FOR 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

Condition	Minimum Respiratory Protection* Required Above 1000 ppm
Vapor Concentration 4500 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 4500 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.