

*T.C. Council*

TRICHLOROETHYLENE

The present revision of this data sheet was prepared by the Industrial Department, National Safety Council, 425 N. Michigan Ave., Chicago 60611 and is published by the Council.

Introduction

1. Trichloroethylene is a common commercial and industrial solvent marketed under such trade names as Blacosolv, Chlorylen, Dow-Tri, Nialk, Perm-A-Clor, Phillex, Triad, Triasol, Triclene, and Trimar. Its properties, the hazards associated with its use, and recommendations for safe handling are discussed in this data sheet.

2. Manufacturers of trichloroethylene and of the equipment in which it is to be used should be consulted on the technical problems of equipment design, ventilation requirements, and operational procedures for maximum safety and economy.

Properties

3. Trichloroethylene ($\text{CHCl}=\text{CCl}_2$) is a colorless volatile liquid with an odor similar to that of chloroform. It is miscible in alcohol, ether, and most organic solvents in all proportions, but practically insoluble in water. It is stable in the presence of air, water, and light with any of the common metals at temperatures up to 248 F (120 C). Other physical properties of trichloroethylene include:

Molecular weight 131.4
Boiling point
(760 mm) 188 F (86.9C)
Freezing point -99 F (-73 C)

The information and recommendations contained in this publication have been compiled from sources believed to be reliable and to represent the best current opinion on the subject. No warranty, guarantee, or representation is made by the National Safety Council as to the absolute correctness or sufficiency of any representation contained in this and other publications, and the National Safety Council assumes no responsibility in connection therewith; nor can it be assumed that all acceptable safety measures are contained in this (and other publications), or that other or additional measures may not be required under particular or exceptional conditions or circumstances.

An Alphabetical Index of all Industrial Safety Data Sheets (Stock No. 123.09) is available from the Council on request.

Specific gravity of liquid
(water = 1.0) 1.46
Specific gravity of vapor
(air = 1.0) 4.54
Vapor pressure at 68 F
(20 C) 60.0 mm Hg
Weight per gallon at 59 F
(15 C) 12.30 pounds

Uses

4. Because trichloroethylene dissolves grease, it is widely used in the cleaning of metals, glass, and certain fabrics. In properly designed equipment, it leaves the cleaned piece dry and in good condition for many subsequent operations. It will not dissolve the water soluble industrial lubricants, such as soaps or sulfonated oils.

5. Trichloroethylene is also used in organic syntheses, in miscellaneous preparations such as liquid

soaps, paint and tar removers, rubber cements, glues, shoe and stove polishes, and in processes such as wool degreasing and depitching.

Containers and shipping

6. Shipping of trichloroethylene is not regulated by the Interstate Commerce Commission. It is shipped in tank cars (ICC Specification 103 or 103W), tank trucks, 55-gallon drums, cans, and bottles.

7. The Manufacturing Chemists Association¹ recommends that all containers of trichloroethylene bear the following label in addition to, or in combination with, any label, warning, or other statement required by local statutes, regulations, or ordinances:

TRICHLOROETHYLENE

WARNING! VAPOR
HARMFUL

Use only with adequate ventilation.

Avoid prolonged or repeated breathing of vapor.

Avoid prolonged or repeated contact with skin.

Do not take internally.

Storage

8. Trichloroethylene may be stored in galvanized iron, black iron, or steel drums or tanks, or in glass containers for long periods without change in its chemical or physical properties. Drums should be kept closed to prevent evaporation and should not be exposed to extreme heat. If trichloroethylene is stored in colorless glass containers, they should be kept away from direct light to prevent the formation of acidic decomposition products. Trichloroethylene may be transferred from one container to another by gravity flow, siphoning, or pumping.

9. Mixtures containing trichloroethylene should be stored in closed containers and used with the same precautions as for pure trichloroethylene.

10. Trichloroethylene vapors are heavier than air and tend to collect in poorly ventilated pockets and other low places. For this reason, containers should not be stored in pits, basements, or unventilated areas.

Handling

11. Trichloroethylene should not be used in open pans or for degreasing in makeshift or homemade apparatus. The design of degreasing equipment should be undertaken only by a competent engineer.

12. Most trichloroethylene degreasing and cleaning is done at a relatively high temperature, usually at or near the boiling point of the solvent, and such high temperature processes require more elaborate control than those at or below room temperature. When trichloroethylene is mixed with a flammable, less volatile solvent, the flash point should be regularly tested to make certain a flammable mixture has not been created due to evaporation.

13. Modern vapor degreasing, dry cleaning, extraction, and other units designed by responsible equipment manufacturers are constructed so that concentrations of vapor in the vicinity are consistently within the accepted safe limits provided that the equipment is correctly operated. It is extremely important, however, that the operators be thoroughly instructed in the use of the unit and be carefully supervised.

14. If excessive concentrations of trichloroethylene are suspected, a competent technician should check the equipment for mechanical condition and review the operating practices used.

15. Workers should be thoroughly informed of the hazards that may result from improper handling of trichloroethylene. They should be cautioned to prevent spills and thoroughly instructed regarding proper action to take in case they occur. Each employee should know what to do in an emergency and should be fully informed as to first-aid measures.

Personal protective equipment

16. Where exposure to trichloroethylene may occur, for example, from spills, workers should wear personal protective equipment to guard against harmful contact with the material or its vapors. Gloves and aprons should be worn to protect the skin from direct contact. Chemical goggles or face shields and safety-toe shoes or boots should be worn. All items of personal protective equipment should be made of material that is resistant to the solvent action of trichloroethylene.

17. Work in a confined area requires the use of respiratory protective equipment approved by the U.S. Bureau of Mines for the specific exposure.

18. A gas mask with canister is adequate only when tests show that the amount of trichloroethylene vapor in the atmosphere is less than 2 per cent by volume and the oxygen content is not less than 16 per cent.

19. If an emergency requires a worker to enter a heavily contaminated area, such as a tank, he should wear either a hose mask with blower or a self-contained breathing apparatus, together with a rescue harness to which a lifeline is attached. Another worker, similarly equipped, should be stationed outside the tank to tend the lifeline and if necessary to assist the man inside.

Ventilation

20. Operations employing trichloroethylene should always be conducted in well-ventilated areas. When a ventilating system is installed, an effort should be made

to have the natural air currents in the vicinity assist rather than oppose the mechanical ventilation. The system should draw the vapor away from the operator rather than through his breathing zone.

21. The discharge from mechanical ventilating systems should be placed far enough from the building so that the exhausted vapors will not create a public nuisance nor re-enter the building to contaminate any area.

22. Specific ventilation requirements depend on the type of equipment used:

- a. For the vapor degreasing² of metals, open machines are used in which the vapor level is controlled by heat input and cooling coils, which establish a vapor "ceiling." Such vapor degreasing units should always be installed in locations free from draft conditions and should be ventilated by horizontal slot exhausts.
- b. Partially enclosed equipment has been designed for the use of trichloroethylene in the dry cleaning industry. This equipment recycles a great part of the solvent vapor to a condenser, thereby minimizing exposure of the worker. A correctly designed machine will prevent seepage of solvent liquid and vapor during the cleaning operation. Partially closed systems are also used for metal degreasing operations in some conveyor type vapor units.
- c. Extraction and other chemical processes using trichloroethylene are done in totally enclosed units.

Fire hazards

23. Underwriters' Laboratories³ classes trichloroethylene as nonflammable at ordinary temperatures and moderately flammable at elevated temperatures. However, its vapors may be decomposed to toxic and corrosive substances if exposed to high temperatures, such as those encountered in open flames, or to radiation from arc welding or cutting operations.

24. Trichloroethylene is sometimes mixed with flammable solvents to produce less flammable mixtures or to increase solvent power. If the flammable solvent is less volatile than trichloroethylene, the trichloroethylene will evaporate more quickly, changing the composition of the mixture and resulting in an increasingly flammable mixture. On the other hand, if a flam-

mable solvent more volatile than trichloroethylene is mixed with trichloroethylene, the vapors from the mixture may be highly flammable.

Symptoms of poisoning

25. In sufficiently high concentrations, trichloroethylene has narcotic properties similar to but slightly less marked than chloroform. Prolonged exposure or frequent short exposures to concentrations higher than 200 parts per million by volume (ppm) may injure the nervous system and possibly the liver. Concentrations moderately higher than 200 ppm may also cause nausea, dizziness, headache, and lethargy. These symptoms, however, do not necessarily indicate systemic poisoning. Repeated inhalation of trichloroethylene vapors may lead to craving and habituation. Concentrations of 160 ppm are just detectable by their odor, and inhalation of 1,300 ppm for six minutes is said to cause vertigo, pressure in the head, fatigue, and irritation of the mucous membranes.

26. Ingestion of trichloroethylene may cause toxic effects similar to those produced by excessive inhalation. Contact of trichloroethylene with the skin causes first irritation and later numbness. Prolonged skin contact may cause formation of blisters and, in addition, remove the protective fat layer of the skin and predispose to secondary infections and eczema.

First aid

27. A person showing evidence of intoxication from the inhalation of trichloroethylene vapors should be moved promptly to fresh air. If breathing has stopped, artificial respiration should be started at once and should be continued until a physician arrives.

28. In case of skin contact, the contaminated clothing should be removed immediately and the affected areas washed thoroughly with warm water and soap. A physician should be consulted because

systemic poisoning or skin irritation (dermatitis) may result from such an exposure.

29. If trichloroethylene should get into the eyes, they should be gently irrigated for at least 15 minutes with large quantities of water. Irrigation should be started immediately. In all such cases, medical attention should be obtained without delay.

Threshold limit values

30. The threshold limit value—the time-weighted average concentration believed safe for continuous exposure during a normal work day—has been established by the American Conference of Governmental Industrial Hygienists⁴ at 100 ppm for trichloroethylene. Samples of air should be taken wherever exposure to trichloroethylene is known or suspected. In most states, advice and assistance may be obtained from the industrial hygiene division of the state health or labor department.

Physical examinations

31. Every applicant for work that may involve exposure to trichloroethylene should be given a pre-employment physical examination. Subsequently, a complete physical examination should be made at least once a year unless the degree of exposure indicates the need for more frequent checking.

32. Generally, individuals who are heavy users of alcoholic liquors, those who are markedly overweight or underweight, and those with evidence of disease of the lungs, liver, kidneys, or heart or with chronic skin conditions should not be exposed to trichloroethylene.

Waste disposal

33. Federal, state, and local regulations with regard to waste disposal should be known and followed. Waste should not under any condition be emptied into a municipal sewer system. The most desirable treatment for any trichloroethylene waste is to recover the

solvents from it in a properly designed and operated still. This procedure can essentially eliminate waste-disposal problems.

ACKNOWLEDGMENT

The present revision of this data sheet was prepared by the Industrial Department of the National Safety Council and reviewed by members of the Technical Publications Committee of the Council's Chemical Section.

REFERENCES

1. Manufacturing Chemists' Association, 1825 Connecticut Ave., NW, Washington, D.C. 20009. *Guide to Precautionary Labeling of Hazardous Materials*. Manual L-1, 1961.
2. National Safety Council, 425 North Michigan Ave., Chicago 60611. *Vapor Degreasers* Data Sheet 429, 1956.
3. Underwriters' Laboratories, Inc., 207 East Ohio St., Chicago 60611. *Gas and Oil Equipment List*, November 1962.
4. American Conference of Governmental Industrial Hygienists, 1014 Broadway, Cincinnati 45202. *Threshold Limit Values for 1963*.

BIBLIOGRAPHY

- American Industrial Hygiene Association, 14125 Prevoist, Detroit 48227. *Trichloroethylene*. Hygienic Guide, 1956.
- American National Standards Institute, 1430 Broadway, New York. *Allowable Concentration of Trichloroethylene* Z37.19.
- Association of Casualty and Surety Companies, Accident Prevention Department, 110 William St., New York 10038. *Trichloroethylene*. Chemical Hazards Information Series C-8, rev. Apr. 1961.
- Manufacturing Chemists' Association, 1825 Connecticut Ave., NW, Washington, D.C. 20009. *Trichloroethylene*. Chemical Safety Data Sheet SD-14, 1956.
- U.S. Bureau of Mines, 4800 Forbes Ave., Pittsburgh 15213. *Flammability of Trichloroethylene*. Report of Investigation 6190, 1963.
- Williams, Jonathan W. "The Toxicity of Trichloroethylene." *Journal of Occupational Medicine*, 1:549 (Oct. 1959).
- Witheredge, W. N., and Herbert T. Walworth. "Ventilation of a Trichloroethylene Degreaser." *Journal of Industrial Hygiene and Toxicology*, 22:175-187 (May 1940).