

criteria for a recommended standard

**OCCUPATIONAL EXPOSURE
TO
1,1,2,2
TETRACHLOROETHANE**



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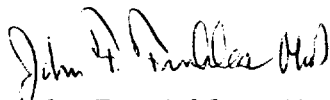
PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the health effects of exposure. The Secretary of Labor will weigh these recommendations along with other considerations such as feasibility and means of implementation in developing regulatory standards.

It is intended to present successive reports as research and epidemiologic studies are completed and as sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this report on 1,1,2,2-tetrachloroethane by members of the NIOSH staff and the valuable constructive comments by the Review Consultants on 1,1,2,2-Tetrachloroethane, by the ad hoc committee of the American Occupational Medicine Association and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine. The NIOSH recommendations for standards are not necessarily a consensus of all the consultants and professional societies

that reviewed this criteria document on 1,1,2,2-tetrachloroethane. A list of Review Consultants appears on page vi.



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CRITERIA DOCUMENT:
RECOMMENDATIONS FOR AN OCCUPATIONAL
EXPOSURE STANDARD FOR 1,1,2,2-TETRACHLOROETHANE

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I. RECOMMENDATIONS FOR A 1,1,2,2-TETRACHLOROETHANE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to 1,1,2,2-tetrachloroethane in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of employees for up to a 10-hour work shift, 40-hour workweek, over a working lifetime. Compliance with all sections of the standard should prevent adverse effects of 1,1,2,2-tetrachloroethane on the health and safety of employees. The standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. Although the workplace environmental limits are considered to be safe levels based on current information, they should be regarded as the upper boundary of exposure and every effort should be made to maintain the exposure at levels as low as is technically feasible. The criteria and standard will be subject to review and revision as necessary.

These criteria and the recommended standard apply to exposure of workers to the symmetrical isomer of the chlorinated hydrocarbon compound, $\text{CHCl}_2 - \text{CHCl}_2$, referred to as 1,1,2,2-tetrachloroethane. Acetylene tetrachloride and sym-tetrachloroethane are synonyms. "Tetrachloroethane" will be used throughout this document to mean the symmetrical isomer unless otherwise stated. The "action level" is defined as one-half the recommended time-weighted average (TWA) environmental limit. "Occupational exposure to tetrachloroethane," because of systemic effects and dermal irritation produced by contact of tetrachloroethane with the skin, is defined as work in an area where tetrachloroethane is stored, produced,

processed, or otherwise used. If an employee is occupationally exposed to airborne concentrations of tetrachloroethane in excess of the action level, then all sections of the recommended standard shall be complied with; if the employee is occupationally exposed at or below the action level, then all sections of the recommended standard shall be complied with except Section 8. If exposure to other chemicals also occurs, provisions of any applicable standards for the other chemicals shall also apply.

Section 1 - Environmental (Workplace Air)

(a) Concentration

When skin exposure is prevented, occupational exposure to tetrachloroethane shall be controlled so that no employee is exposed to tetrachloroethane at a concentration greater than 1.0 part per million parts of air by volume (6.87 milligrams per cubic meter of air) determined as a TWA concentration for up to a 10-hour workday, 40-hour workweek.

(b) Sampling and Analysis

Procedures for the collection and analysis of environmental samples shall be as provided in Appendices I and II, or by any method shown to be at least equivalent in precision, accuracy, and sensitivity to the methods specified.

Section 2 - Medical

Medical surveillance shall be made available to all persons subject to occupational exposure to tetrachloroethane as described below.

(a) Preplacement medical examinations shall include at least:

(1) Comprehensive medical and work histories with special emphasis directed to symptoms related to the liver, kidneys, and nervous system. Information about exposure to other chemicals should be recorded, as should episodes of nausea, vomiting, dizziness, or headaches.

(2) A physical examination.

(3) Liver function tests, such as serum transaminase determinations, shall be performed, and screening tests of nervous system function should be considered by the responsible physician.

(4) Judgment of the worker's ability to use positive or negative pressure respirators.

(b) Periodic examinations shall be made available at least on an annual basis, or more frequently as determined by the responsible physician. These examinations shall include at least:

(1) Interim medical and work histories.

(2) A physical examination as described above for the preplacement examination.

(c) During examinations, applicants or employees having medical conditions which would be directly or indirectly aggravated by exposure to tetrachloroethane shall be counseled on the increased risk of impairment of their health from working with this substance.

(d) Initial medical examinations shall be made available to all workers within 6 months after promulgation of a standard based on these recommendations.

(e) If known or suspected exposure to tetrachloroethane vapor at a concentration above the TWA limit occurs, or if contact with the liquid

occurs, a physical examination, as described for preplacement examinations, and any other tests, as determined by the attending physician, shall be made available within a reasonable period of time.

(f) In an emergency involving tetrachloroethane, all affected personnel shall be provided with immediate first aid, followed by prompt medical evaluation and care. In the event of skin or eye contact with liquid tetrachloroethane, contaminated clothing and shoes shall be removed immediately, and eyes and skin shall be flushed with copious amounts of water. In all cases of eye contact or inhalation exposure, a physician shall be alerted. The medical attendants shall be informed of the possibility of central nervous system depression and, because of the severe toxicity of tetrachloroethane, persons so exposed shall be observed for a minimum of 24 hours after exposure. Examinations as described in paragraph (e) of this section should be made available as warranted by results of the 24-hour observation period.

(g) Pertinent medical records shall be maintained by the employer for all employees occupationally exposed to tetrachloroethane. Such records shall be retained for at least 30 years after termination of employment. These records shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, and of the employer, employee, or former employee.

Section 3 - Labeling and Posting

(a) Labeling

All vessels containing tetrachloroethane shall carry in a readily visible location a label stating:

1,1,2,2-TETRACHLOROETHANE
(ACETYLENE TETRACHLORIDE)

WARNING!

HARMFUL IF INHALED
HARMFUL IF ABSORBED THROUGH SKIN

Avoid breathing of vapor.
Avoid contact with skin, eyes, and clothing.
Keep containers closed when not in use.
Use only with adequate ventilation.

(b) Posting

Areas where tetrachloroethane is present shall be posted with a sign reading:

1,1,2,2-TETRACHLOROETHANE
(ACETYLENE TETRACHLORIDE)

WARNING!

HARMFUL IF INHALED
HARMFUL IF ABSORBED THROUGH SKIN

Avoid breathing of vapor.
Avoid contact with skin, eyes, and clothing.
Keep containers closed when not in use.
Do not enter areas where used or stored unless adequate ventilation is provided.

All labels and warning signs shall be printed both in English and in the predominant language of non-English-reading employees. All employees shall be trained verbally and informed of the hazardous areas, with special instruction given to illiterate employees and employees reading only languages other than those used on labels and posted signs.

Section 4 - Personal Protective Equipment

Engineering controls shall be used if needed to maintain tetrachloroethane concentrations at or below the prescribed limit. When necessary, these shall be supplemented by the use of personal protective equipment. Requirements for personal protective equipment shall be in accordance with provisions of 29 CFR 1910, Subpart I.

(a) Eye Protection

Chemical safety goggles, face shields and goggles, or safety glasses with side shields shall be provided by the employer and shall be worn during any operation in which tetrachloroethane is present (29 CFR 1910.133).

(b) Skin Protection

Protective clothing, including gloves, aprons, suits, boots, and face shields (8-inch minimum) and goggles, made of a material resistant to tetrachloroethane, shall be worn where needed to prevent skin contact.

(c) Respiratory Protection

(1) Compliance with the permissible exposure limit may be achieved by the use of respirators only:

(A) During the time necessary to install or test the required engineering controls.

(B) During emergencies or during the performance of nonroutine maintenance or repair activities when air concentrations of tetrachloroethane may exceed the permissible environmental limit.

(2) When use of a respirator is permitted, it shall be selected and used pursuant to the following requirements:

(A) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134.

(B) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator provided when necessary. The respiratory protective devices in conformance with Table I-1 shall comply with the standards jointly approved by NIOSH and the Mining Enforcement and Safety Administration (MESA, formerly Bureau of Mines) as specified under the provisions of 30 CFR 11.

(C) Respirators specified for use in higher concentrations of tetrachloroethane may be used in atmospheres of lower concentrations.

(D) The employer shall ensure that respirators are adequately cleaned and maintained, and that employees are trained and drilled, at least annually, in the proper use and testing for leakage of respirators assigned to them.

(E) Respirators shall be easily accessible, and employees shall be informed of their location.

TABLE I-1

RESPIRATOR SELECTION GUIDE

Concentrations of Tetrachloroethane	Respirator Type
Less than or equal to 10 ppm	(1) Chemical cartridge respirator with half-mask facepiece and organic vapor cartridge (2) Supplied-air respirator, demand type, with half-mask facepiece
Less than or equal to 50 ppm	(1) Chemical cartridge respirator with full facepiece and organic vapor cartridge (2) Gas mask with chin-style or front- or back-mounted organic vapor canister (3) Supplied-air respirator operated in demand mode with full facepiece (4) Self-contained breathing apparatus operated in demand mode with full facepiece
Less than or equal to 150 ppm	(1) Type C supplied-air respirator with full facepiece, helmet, hood, or suit and operated in continuous-flow mode (2) Type C supplied-air respirator with full facepiece operated in pressure-demand mode
Greater than 150 ppm	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece and auxiliary self-contained air supply operated in pressure-demand mode
Emergency or Entry (into an area of unknown concentration, eg, firefighting)	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece and auxiliary self-contained air supply operated in pressure-demand mode
Evacuation or Escape (from an area of unknown concentration)	(1) Any gas mask providing protection from organic vapors (2) Any self-contained breathing apparatus

Section 5 - Informing Employees of Hazards from 1,1,2,2-Tetrachloroethane

(a) The employer shall ensure that each employee occupationally exposed to tetrachloroethane is informed at the beginning of employment or on assignment to a tetrachloroethane area of the hazards, relevant symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions for the safe use of tetrachloroethane. This information shall also include a description of the general nature of the medical surveillance procedures and why it is advantageous to the workers to undergo these examinations. Employees engaged in maintenance and repair shall be included in these training programs. The employee shall be reformed at least once annually. Each employee shall be advised of the availability of such relevant information, including the material safety data sheet which shall be kept on file.

(b) Required information shall be recorded on the "Material Safety Data Sheet" shown in Appendix III or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices

(a) Engineering controls, such as process enclosure or local exhaust ventilation, shall be used as needed to maintain tetrachloroethane concentrations within the recommended environmental limit. Ventilation systems, if used, shall be designed to prevent the accumulation or recirculation of tetrachloroethane in the workplace, to maintain the tetrachloroethane concentrations within the limit of the recommended standard, and to effectively remove tetrachloroethane from the breathing zones of employees. Adequate, uncontaminated makeup air shall be provided.

Exhaust ventilation systems discharging into outside air must conform with applicable local, state, and federal air pollution regulations and must not constitute a hazard to employees or to the general population. Ventilation systems shall be subject to regular preventive maintenance and cleaning to ensure effectiveness, which shall be verified by airflow measurements taken at least every 3-6 months.

(b) Storage, Handling, and General Work Practices

(1) Containers of tetrachloroethane shall be kept tightly closed at all times when not in use. Only properly informed, trained, and equipped personnel shall be involved in storing, loading and unloading, or processing tetrachloroethane. Tetrachloroethane shall be stored in locations that are adequately ventilated and cool, and not in pits, depressions, or basements. Storage containers shall be periodically inspected for leakage and deterioration.

(2) Washing of hands, equipment, or structures with tetrachloroethane shall be prohibited.

(3) Prior to maintenance work, sources of tetrachloroethane and its vapor shall be eliminated to the extent feasible. If concentrations at or below the recommended workplace air limit cannot be assured, respiratory protective equipment shall be used during such maintenance work.

(4) Written operating instructions and first-aid procedures shall be formulated and posted by the employer where tetrachloroethane is handled or used.

(5) Tetrachloroethane containers and systems shall be inspected periodically for leaks. All tetrachloroethane equipment

including valves, fittings, and connections shall be checked for tightness and good working order. All newly made connections shall be checked for leaks immediately after tetrachloroethane is introduced. Needed repairs and adjustments shall be made promptly.

(6) An employee whose skin becomes contaminated with liquid tetrachloroethane shall immediately wash or shower. Clothing contaminated with the liquid shall be either disposed of or cleaned before reuse. Anyone handling or responsible for cleaning contaminated clothing shall be instructed as to the hazards, relevant symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions for the safe handling and use of tetrachloroethane. Some materials which cannot be effectively decontaminated, such as leather and rubber, shall be discarded.

(7) Transportation and use of tetrachloroethane shall comply with all applicable federal, state, and local regulations.

(c) Waste Disposal

Waste material contaminated with liquid tetrachloroethane shall be disposed of in a manner not hazardous to employees and conforming to all applicable local, state, and federal regulations. Incineration, properly conducted to prevent the release of hazardous combustion products such as hydrochloric acid and chlorine, is an acceptable means of disposal.

(d) Confined Spaces

(1) Entry into confined spaces, such as tanks, pits, tank cars, barges, process vessels, and tunnels, where tetrachloroethane has been present shall be controlled by a permit system. Permits signed by an authorized employer representative shall certify that preparation of the

confined space, precautionary measures, and personal protective equipment are adequate, and that precautions have been taken to ensure that prescribed procedures will be followed.

(2) Individuals entering confined spaces where they may be exposed to tetrachloroethane shall wear respirators as specified in Section 4.

(3) Confined spaces which have contained tetrachloroethane shall be inspected and tested for oxygen deficiency and for tetrachloroethane and other known or suspected contaminants and, prior to entry, shall be thoroughly ventilated and decontaminated.

(4) Accidental exposure to tetrachloroethane in confined spaces shall be prevented by disconnecting and blanking off tetrachloroethane supply lines.

(5) Confined spaces shall be ventilated while work is in progress therein to keep the concentration of tetrachloroethane at or below the workplace environmental limit and to prevent oxygen deficiency.

(6) When a person enters a confined space, another properly protected worker shall be on standby outside.

(e) Emergency Procedures

For all work areas where there is a reasonable potential for accidents involving tetrachloroethane, the procedures specified below shall be used, and any others appropriate for a specific operation or process shall be formulated in advance. Employees shall be instructed in their implementation.

(1) Procedures shall include prearranged plans for obtaining emergency medical care and for the transportation of injured

workers. Employees shall also be trained in administering immediate first aid and shall be prepared to render such assistance when necessary.

(2) Approved eye, skin, and respiratory protection as specified in Section 4 shall be used by persons who are involved in the cleanup operations at the accident site.

(3) Eyewash fountains and emergency showers shall be provided in accordance with 29 CFR 1910.151.

(4) Employees not essential to cleanup operations shall be evacuated from exposure areas during emergencies. Perimeters of hazardous exposure areas shall be delineated, posted, and secured. Employees in adjacent areas shall be informed of evacuation procedures in the event that their work areas become involved.

(5) Only personnel properly trained in emergency procedures and adequately protected against the attendant hazards shall be assigned to shut off sources of tetrachloroethane, clean up spills, and repair leaks.

(6) Spilled tetrachloroethane shall be cleaned up promptly. Small spills can be soaked up by absorbent material; larger spills, after being contained, can be pumped into drums or tanks. Waste disposal shall conform to Section 6(c) of this chapter.

Section 7 - Sanitation

(a) Plant sanitation shall meet the requirements of 29 CFR 1910.141.

(b) Food preparation, dispensing (including vending machines), and eating shall be prohibited in work areas where tetrachloroethane is present.

(c) Employees who handle liquid tetrachloroethane shall be instructed to wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

Section 8 - Monitoring and Recordkeeping Requirements

Within 6 months of the promulgation of a standard based on these recommendations, each employer who has a place of employment in which tetrachloroethane is present shall determine by an industrial hygiene survey if exposure to airborne tetrachloroethane at concentrations above the action level may occur. Records of these surveys, including the basis for concluding that air levels are at or below the action level, shall be maintained. Surveys shall be repeated at least once every year and within 30 days of any process change likely to result in an increase of airborne tetrachloroethane concentrations. If it has been decided that the environmental concentration of tetrachloroethane may exceed the action level, then the following requirements shall apply:

(a) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or to permit calculation of, the exposure of all employees occupationally exposed to airborne tetrachloroethane. Source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of the exposure to airborne tetrachloroethane in the breathing zone of the employee shall be collected.

(3) For each TWA determination, a sufficient number of samples shall be taken to characterize employee exposures during each work

shift. Variations in work and production schedules, as well as employee locations and job functions, shall be considered in decisions on sampling locations, times, and frequencies.

(4) Each operation in each work area shall be sampled at least once every 3 months or as otherwise indicated by a professional industrial hygienist. If an employee is found to be exposed at a level in excess of the TWA environmental limit, the exposure of that employee shall be measured at least once every 30 days, control measures shall be initiated, and the employee shall be notified of the exposure and of the control measures being implemented. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, indicate that employee exposure no longer exceeds the environmental limit. Quarterly monitoring may then be resumed.

(b) Recordkeeping

Records of environmental monitoring shall be maintained for at least 30 years. These records shall include the dates and times of measurements, job function and location of the employees within the worksite, sampling and analytical methods used, number, duration, and results of the samples taken, TWA concentrations estimated from these samples, type of personal protective equipment used, if any, and exposed employees' names. Employees shall have access to information on their own environmental exposures. These records shall be available to the authorized representatives of the Secretary of Health, Education, and Welfare, and of the Secretary of Labor. Pertinent medical records shall be retained for 30 years after termination of employment. Records of environmental exposures applicable to an employee should be included in that employee's medical records. These

medical records shall be made available to the designated medical representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, of the employer, and of the employee or former employee.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational disease or injury arising from exposure to tetrachloroethane. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria from which standards can be established to protect the health of employees from exposure to hazardous chemical and physical agents. Any criteria and recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work environments. Simple compliance with the recommended standard should not be the final goal.

These criteria for a standard for tetrachloroethane are part of a continuing series of documents published by NIOSH. The recommended standard applies only to the processing, manufacture, and use of tetrachloroethane as applicable under the Occupational Safety and Health Act of 1970. The standard was not designed for the population-at-large, and any extrapolation beyond occupational exposures is not warranted. It

is intended to protect against the development of systemic toxic effects and local effects on the skin and eyes of workers and be measurable by techniques that are valid, reproducible, and available to industry and government agencies.

The major concerns in occupational exposure to tetrachloroethane are its potentials for causing hepatic, gastrointestinal, and neurologic effects. In addition, tetrachloroethane can cause central nervous system depression and mucosal irritation. Because the available evidence indicates that employees can be adversely affected by skin contact with tetrachloroethane, adherence to all provisions of the recommended standard except for environmental monitoring is required in all work areas in which tetrachloroethane is used regardless of its airborne concentration.

The development of the recommended standard for occupational exposure to tetrachloroethane revealed areas that require further research. Epidemiologic studies of workers exposed to tetrachloroethane are desirable to elucidate the effects of tetrachloroethane exposure at or below the recommended workplace environmental limit for extended periods. Experiments to assess the possible carcinogenic, mutagenic, and teratogenic potential of tetrachloroethane also are needed.