

criteria for a recommended standard

**OCCUPATIONAL EXPOSURE
TO
TRICHLOROETHYLENE**



**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
National Institute for Occupational Safety and Health**

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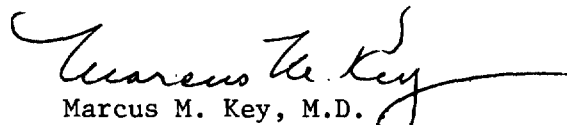
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PREFACE

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. To provide relevant data from which valid criteria and effective standards can be deduced, the National Institute for Occupational Safety and Health (NIOSH) has projected a formal system of research, with priorities determined on the basis of specified indices.

It is intended to present successive reports as research and epidemiologic studies are completed and 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 trichloroethylene by members of my staff and the valuable constructive comments by the Review Consultants on Trichloroethylene, by the ad hoc committees of the American Conference of Governmental Industrial Hygienists and the Society of Toxicology, by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, and by Edwin C. Hyatt on respiratory protection. The NIOSH recommendations for standards are not necessarily a consensus of all of the consultants and professional societies that reviewed this criteria document on trichloroethylene. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.


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The Office of Research and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for trichloroethylene. George D. Clayton and Associates developed the basic information for consideration by NIOSH staff and consultants under contract No. HSM-99-72-129. Robert E. Seiter served as criteria manager and had NIOSH program responsibility for development of the document.

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CRITERIA DOCUMENT:
RECOMMENDATIONS FOR AN OCCUPATIONAL
EXPOSURE STANDARD FOR TRICHLOROETHYLENE

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I. RECOMMENDATIONS FOR A TRICHLOROETHYLENE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to trichloroethylene in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for an 8-hour day, 40-hour week over a working lifetime. Compliance with the standard should therefore prevent adverse effects of trichloroethylene on the health and safety of workers. Occupational exposure to trichloroethylene is defined as exposure to half of the time-weighted average limit of trichloroethylene in air or greater.

The recommended standard is measurable by techniques that are valid, reproducible, and available to industry and governmental agencies. Sufficient technology exists to permit compliance with the recommended standard. Pertinent new information will be reviewed periodically and the recommendations will be revised as necessary.

Section 1 - Environmental (Workplace air)

(a) Concentration

(1) Occupational exposure to trichloroethylene shall be controlled so that workers will not be exposed to trichloroethylene at a concentration in excess of 100 ppm determined as a time-weighted average (TWA) exposure for an 8-hour workday, as measured by a minimum sampling time of 10 minutes.

(2) No worker shall be exposed to a peak concentration of trichloroethylene in excess of 150 ppm, as measured by a maximum sampling time of 10 minutes.

(b) Sampling, Calibration, and Analysis

Procedures for collection of environmental samples shall be as provided in Appendix I, or by an equivalent method. Analysis of samples shall be as provided in Appendix II, or by any method shown to be equivalent in precision, sensitivity, and accuracy to the method specified in Appendix II.

Section 2 - Medical

(a) Medical surveillance as specified in this section shall be made available to workers who are exposed to trichloroethylene.

(1) A preplacement examination shall be made available to all workers who will be exposed to trichloroethylene and within 6 months to all workers who are exposed to trichloroethylene on the effective date of this standard, and it shall consist of:

(A) A comprehensive medical history of each work applicant shall be taken. The history should be directed towards but not limited to the incidence of headaches, nausea, and dizziness; particular attention should be focused on complaints and evidence of eye, mucous membrane and skin irritation. Workers who complain of chronic eye irritation should have an ophthalmic (eye) examination.

(B) A comprehensive physical examination shall be made available, with emphasis on cardiac, pulmonary, liver, and kidney examinations.

(2) Periodic medical examinations shall be made available to workers exposed to trichloroethylene annually.

(3) Medical records shall include all required medical examinations. These records shall be available to the medical representatives of the employer, of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, and, at the employee's request, to the employee's physician. These records shall be kept for at least ten years after the last occupational exposure to trichloroethylene.

Section 3 - Labeling (Posting)

(a) The following warning sign shall be affixed in a readily visible location on processing and other equipment, on trichloroethylene storage tanks or containers, and at or near entrances to areas where exposure to trichloroethylene is likely to occur:

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 liquid internally.

Keep trichloroethylene away from open flame and ultra-
flame and ultraviolet radiation.

(b) If environmental levels are at or greater than the environmental standard, or if a variance permitting use of respiratory

protection has been granted, add information to the label or placard describing the location of the respirators.

Section 4 - Personal Protective Equipment and Clothing

Subsection (a) shall apply whenever a variance from the standard recommended in Section 1 is granted under provisions of the Occupational Safety and Health Act, or in the interim period during the application for a variance. When the limits of exposure prescribed in subsection (a) of Section 1 cannot be met by limiting the concentration of trichloroethylene in the work environment, an employer must establish and enforce, as provided below in subsection (a), a program of respiratory protection to provide the required protection of every worker exposed. Engineering controls shall be used wherever feasible to maintain trichloroethylene concentrations below the prescribed limits.

(a) Respiratory Protection

(1) Only appropriate respirators, as defined below, shall be provided and used when a variance which allows the use of respirators as a means of controlling exposure for routine operations has been granted or while action on application for a variance is pending.

(2) The requirements set forth in this section shall apply for nonroutine operations such as a brief exposure to concentrations in excess of the environmental standard as a result of maintenance or repair activities or in emergency situations.

(3) A respiratory protection program meeting the general requirements outlined in section 3.5 of American National Standard Practices for Respiratory Protection Z88.2-1969 shall be established and enforced by the employer. This program shall include instructions on the selection, fitting, use, testing for leakage, cleaning, and maintenance of the respiratory protective devices.

(4) For the purpose of determining the class of respirator to be used, the employer shall measure the atmospheric concentration of trichloroethylene in the workplace when the initial application for variance is made and thereafter whenever process, worksite, climate or control changes occur which are likely to affect the concentrations of airborne trichloroethylene. Only appropriate respirators as described in Table I-1 shall be used and shall be approved either under the appropriate Bureau of Mines Schedules or under 30 CFR 11 published March 25, 1972.

(5) Employees who experience breathing difficulty while wearing a respirator shall be medically examined to determine their ability to wear the respirator.

Table I-1

REQUIREMENTS FOR RESPIRATOR USAGE AT CONCENTRATIONS
ABOVE THE STANDARD

<u>8 Hr. TWA</u>	<u>Respirator Type</u>
Less than 1000 ppm	Chemical cartridge respirator with organic vapor cartridge(s). Type C demand type supplied air respirator with half mask facepiece.
Less than 5000 ppm	Gas mask, chin type, with organic vapor canister.
Less than 10000 ppm or equal	Type C demand type supplied air respirator with full facepiece.
Greater than 10000 ppm	Type C continuous flow supplied air respirator. Self-contained breathing apparatus in pressure-demand mode (positive pressure). The self-contained breathing apparatus shall be made available and used for emergencies.

(b) Protective Clothing

Protective clothing is normally not required for most operations using trichloroethylene. Operations where splashing, spilling, spraying, etc, or skin contact with trichloroethylene may occur

require special protective clothing. Those working in such operations shall use protective clothing made of polymer impervious to trichloroethylene such as neoprene. For any operation that necessitates skin exposure to trichloroethylene, the employee shall be provided gloves with gauntlets and bib-type apron and/or protective clothing made of a material impervious to trichloroethylene. Aprons shall be of the bib type and extend below the boot top. Shoes shall be of neoprene or covered by overshoes (disposable) of a polymer material impervious to trichloroethylene.

(c) Eye Protection

Eye protection shall be provided for any employee working in an operation that might result in liquid getting into the eye. Face shields shall be worn with respirator as described above when the operation requires such protection and a spray of trichloroethylene is possible. Suitable eye protection shall be in accordance with 29 CFR part 1910.13; this was published in the Federal Register, Volume 37, Number 202, page 22231, dated October 18, 1972.

Section 5 - Appraisal of Employees of Hazards
from Trichloroethylene

(a) Each employee exposed to trichloroethylene and its decomposition products shall be apprised of all hazards, the consequences of overexposure, appropriate emergency procedures, proper conditions for safe use, and precautions to minimize exposure. This appraisal shall include, as a minimum, all information set forth in

Appendix III which is applicable to that specific product or material containing trichloroethylene.

(b) Each employee shall be apprised of the location of the information prescribed in paragraph (c) of this section. This information shall be kept on file and shall be readily accessible to all employees at each establishment where exposure to trichloroethylene occurs.

(c) Information as specified in Appendix III shall be recorded on U.S. Department of Labor Form OSHA-20 "Material Safety Data Sheet" or a similar form approved by the Occupational Safety and Health Administration, U.S. Department of Labor.

Section 6 - Work Practices

(a) Emergency Procedures

Emergency procedures, including those necessary for fire fighting, shall be established.

(b) Exhaust Systems

Engineering procedures shall be established to reduce exposure of employees to trichloroethylene vapors through implementation of adequate ventilation methods. Where a local exhaust ventilation system is used, it shall be designed and maintained to prevent the accumulation or recirculation of trichloroethylene vapor into the workroom.

(c) General Housekeeping

Emphasis shall be placed upon immediate cleanup of spills, periodic inspection, immediate repair of equipment and leaks, and

proper storage and disposal of materials to prevent airborne contamination and accidental skin contact with trichloroethylene.

(d) Disposal

(1) Disposal of small quantities of trichloroethylene can be accomplished by pouring the liquid onto a mixture of 10% soda ash and sand and placing the mixed material in a paper container and incinerating.

(2) Waste from cleaning contaminated with trichloroethylene should be stored in a ventilated area until ready for disposal and may be burned in an incinerator.

(e) Special Precautions

(1) Operations which generate or create high temperatures or sources of radiant energy such as those encountered in open flames, unshielded (unventilated) resistance heating, arc welding or cutting, and high intensity ultraviolet light shall not be located or conducted in areas where vapors of trichloroethylene are present.

(2) Smoking should not be permitted in areas where vapor of trichloroethylene is present.

(3) Powdered metals or turnings shall not be used or stored in any area where trichloroethylene liquid is in use or stored.

Section 7 - Sanitation Practices

Showers, hand-washing facilities, soap, and water shall be available.

Section 8 - Monitoring and Recordkeeping Requirements

Workroom areas where it has been determined, on the basis of an industrial hygiene survey or the judgment of a compliance officer, that environmental levels of trichloroethylene are less than half of the TWA limit shall not be considered to have trichloroethylene exposure. Records of these surveys, including the basis for concluding that air levels of trichloroethylene are below half of the TWA limit, shall be kept. Requirements set forth below apply to trichloroethylene exposures.

(a) Employers shall maintain records of environmental exposures of workers to trichloroethylene based upon the sampling and recording schedule presented below.

(1) Semiannual Requirements

Samples shall be collected in the breathing zone of representative employees at least semiannually for specific work operations. The first sampling period shall be completed within 180 days of the effective date of this standard. Sampling shall also be done whenever process, worksite climate or control changes occur which are likely to affect the concentrations of airborne trichloroethylene. Samples shall be collected and evaluated for both time-weighted average and ceiling values. The following number of breathing-zone samples shall be collected and analyzed, as a minimum, based on the number of workers exposed in any trichloroethylene exposure area:

Maximum Number of Employees

Number of Samples

Exposed at any Given Time

1-20	5 samples or 50% of the total number of workers, whichever is greater
20-100	10 samples plus 25% of the excess over 20 workers
over 100	30 samples plus 25% of the excess over 100 workers

(2) Thirty-Day Requirements

The sampling regimen shall be conducted every 30 days for work areas or job activities for which the time-weighted average or ceiling concentrations are in excess of the environmental standard. Sampling, monitoring, and recordkeeping provisions of the 30-day schedule shall be required until two consecutive 30-day sampling periods have indicated that the concentrations of trichloroethylene are within the limits specified in Section 1.

(b) Records shall be maintained for ten years for all sampling schedules to include the sampling methods, analytical methods, type of respiratory protection in use (if applicable), and the concentrations of trichloroethylene in each work area. Records shall be maintained so that they can be classified by employee.

(c) Each worker shall have access to the results of samplings as they pertain to his occupational exposure.

(d) Medical records shall include information on all required medical examinations. These records shall be kept for at least ten years following the last occupational exposure to trichloroethylene.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to trichloroethylene. 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 upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents.

These criteria for a standard for trichloroethylene are in a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of trichloroethylene in products as applicable under the Occupational Safety and Health Act of 1970.

These criteria were not developed for the population-at-large and any extrapolation beyond general occupational exposures is not warranted. They are intended to assure that the standard based thereon will (1) protect against development of acute and chronic

trichloroethylene poisoning, (2) be measurable by techniques that are valid, reproducible, and available to industry and official agencies, and (3) be attainable with existing technology.