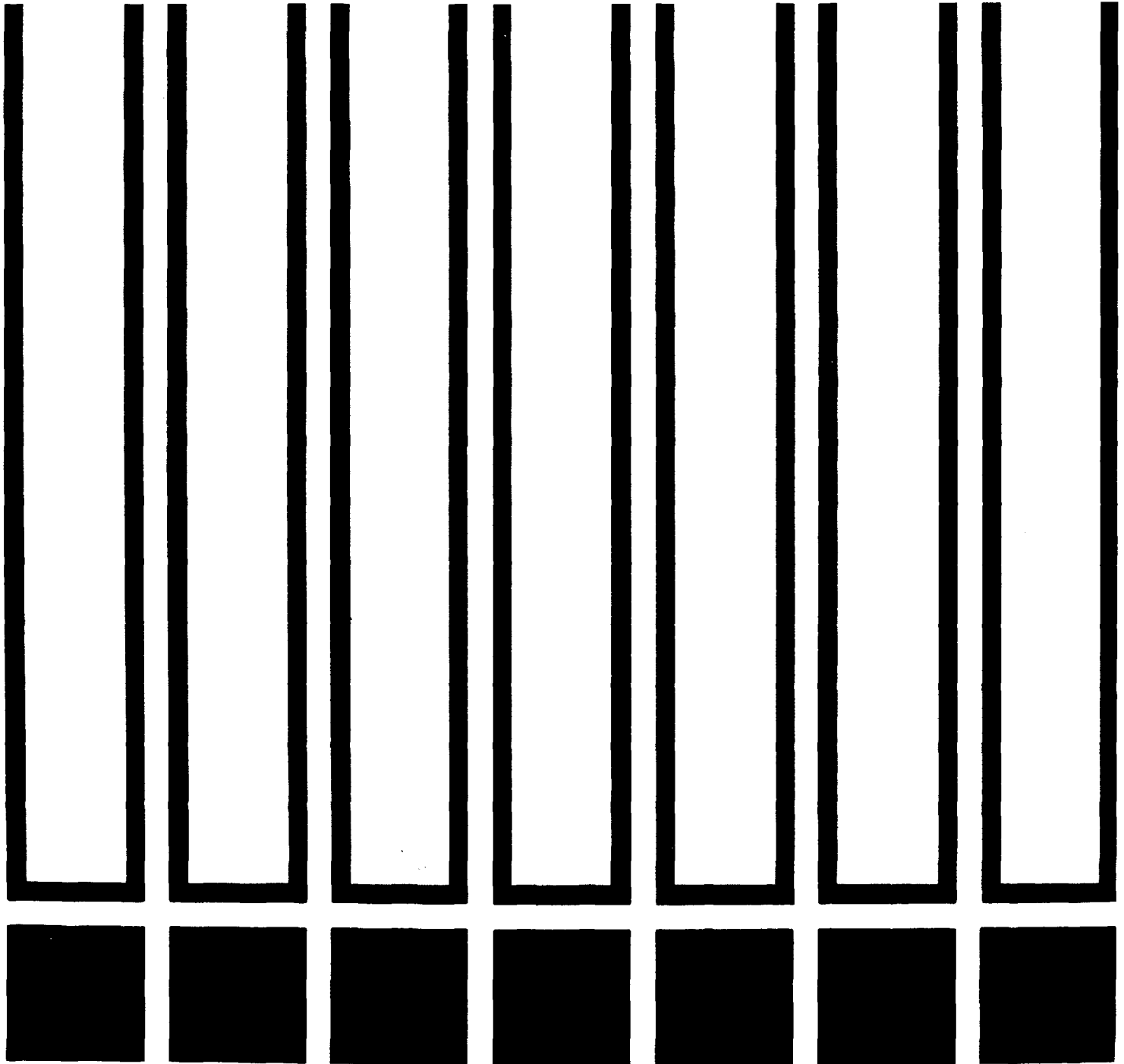


**NIOSH**

**criteria for a recommended standard . . . .  
occupational exposure to**

**CARBON TETRACHLORIDE**



**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE**

Public Health Service    Center for Disease Control  
National Institute for Occupational Safety and Health

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**OCCUPATIONAL EXPOSURE  
TO  
CARBON TETRACHLORIDE**



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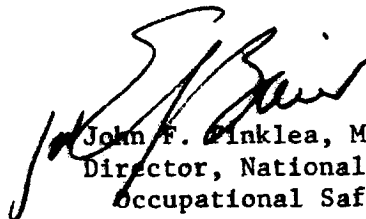
## PREFACE

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 carbon tetrachloride by members of my staff and the valuable, constructive comments by the Review Consultants on carbon tetrachloride, by the ad hoc committees of the American Industrial Hygiene Association and the Society of Occupational and Environmental Health, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, and by William M. Pierce on respiratory protection and work practices. The NIOSH recommendations for standards are not necessarily a consensus of all the consultants and

professional societies that reviewed this criteria document on carbon tetrachloride. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.

A handwritten signature in black ink, appearing to read "John F. Pinklea".

John F. Pinklea, M.D.  
Director, National Institute for  
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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 carbon tetrachloride. Agatha Corporation developed the basic information for consideration by NIOSH staff and consultants under contract No HSM-99-73-20. Jon R. May, Ph.D., had NIOSH program responsibility. Final preparation of the document was accomplished by Robert W. Mason, Ph.D.

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CRITERIA DOCUMENT: RECOMMENDATIONS FOR AN OCCUPATIONAL  
EXPOSURE STANDARD FOR CARBON TETRACHLORIDE

Table of Contents

	<u>Page</u>
PREFACE	iii
REVIEW COMMITTEES	vi
I. RECOMMENDATIONS FOR A CARBON TETRACHLORIDE STANDARD	
Section 1 - Environmental (Workplace Air)	1
Section 2 - Medical	2
Section 3 - Labeling (Posting)	3
Section 4 - Personal Protective Equipment and Clothing	3
Section 5 - Informing Employees of Hazards from Carbon Tetrachloride	7
Section 6 - Work Practices	8
Section 7 - Monitoring and Recordkeeping	10
II. INTRODUCTION	13
III. BIOLOGIC EFFECTS OF EXPOSURE	
Extent of Exposure	15
Historical Reports	16
Effects on Humans	18
Epidemiologic Studies	34
Animal Toxicity	41
Correlation of Exposure and Effect	63
IV. ENVIRONMENTAL DATA AND BIOLOGIC EVALUATION OF EXPOSURE	
Environmental Concentrations	70
Environmental Sampling and Analytical Method	75
Biologic Evaluation of Exposure	81
V. DEVELOPMENT OF STANDARD	
Basis for Previous Standards	84
Basis for Recommended Environmental Standard	88
VI. WORK PRACTICES	97
VII. REFERENCES	102
VIII. APPENDIX I - Sampling Procedure for Collection of Carbon Tetrachloride	113
IX. APPENDIX II - Analytical Procedure for Determination of Carbon Tetrachloride	116
X. APPENDIX III - Material Safety Data Sheet	124
XI. TABLES	134

## I. RECOMMENDATIONS FOR A CARBON TETRACHLORIDE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that worker exposure to carbon tetrachloride (CCl<sub>4</sub>) in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for up to a 10-hour workday, 40-hour workweek over a working lifetime; compliance with the standard should therefore prevent adverse effects of carbon tetrachloride on the health and safety of workers. The 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. The standard will be subject to review and revision as necessary.

"Occupational exposure to carbon tetrachloride" is defined as exposure above half the time-weighted average (TWA) environmental limit. Exposures at lower environmental concentrations will not require adherence to the following sections, except that because liquid carbon tetrachloride is absorbed through the skin and because spills are extremely hazardous, Sections (3), (4)(b) and (c), (5) and (6)(d) shall be complied with wherever carbon tetrachloride is used.

### Section 1 - Environmental (Workplace Air)

#### (a) Concentration

Occupational exposure shall be controlled so that workers are not exposed to carbon tetrachloride in excess of 2 ppm (12.6 mg/cu m) determined as a time-weighted average (TWA) exposure for up to a 10-hour workday, 40-hour workweek.

(b) Sampling and Analysis

Procedures for sampling and analysis of workroom air for compliance with the standard shall be as provided in Appendices I and II or by any equivalent method.

Section 2 - Medical

(a) Comprehensive preplacement and annual medical examinations shall be made available to all workers exposed to carbon tetrachloride unless a different frequency is indicated by professional medical judgment based on such factors as emergencies, variations in work periods, and preexisting health status of individual workers.

(b) These examinations shall include, but shall not be limited to:

(1) A comprehensive and interim medical and work history to include occurrence of nausea, vomiting, visual disturbances, and use of alcohol and barbiturates.

(2) A comprehensive medical examination, giving particular attention to kidneys, eyes (black and white and color visual fields), and appropriate tests of liver function.

(3) An evaluation of the worker's physical ability to safely wear a respirator.

(c) Employees shall be counseled regarding the increased hazards from working with carbon tetrachloride resulting from use of alcohol and barbiturates.

(d) Medical records shall be maintained for all persons employed in work involving exposure to carbon tetrachloride. All pertinent medical

records with supporting documents shall be maintained for 20 years after the individual's employment is terminated. The medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employer, and of the employee or former employee shall have access to these records.

Section 3 - Labeling (Posting)

The following warning sign shall be affixed in a readily visible location on processing or other equipment, on carbon tetrachloride storage tanks, or containers, and at or near entrances to areas in which there is occupational exposure to carbon tetrachloride:

CARBON TETRACHLORIDE  
WARNING!  
INHALING VAPOR IS  
HAZARDOUS TO HEALTH  
Avoid breathing of vapor  
Keep containers closed when not in use  
Use only with adequate ventilation  
MAY BE ABSORBED THROUGH SKIN  
Avoid skin or eye contact

This sign shall also be printed in the predominant language of non-English-speaking workers. All employees shall be trained and informed of the hazardous areas with special instructions given to illiterate workers.

Section 4 - Personal Protective Equipment and Clothing

(a) Respiratory Protection

(1) Engineering controls shall be used wherever necessary and feasible to maintain carbon tetrachloride concentrations at or below the prescribed limit. Compliance with the permissible exposure limit may

be achieved by the use of respirators only:

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

(B) For nonroutine operations such as brief exposure to concentrations in excess of the environmental limit for maintenance or repair activities.

(C) During emergencies when air concentrations of carbon tetrachloride may exceed the permissible limit.

(2) When respirators are permitted by paragraph (1) of this section, a respirator program meeting the requirements of 29 CFR 1910.134 and 30 CFR 11.2-1 shall be established and enforced by the employer.

(3) Only appropriate respirators as described in Table I-1 shall be used pursuant to the following requirements:

(A) For the purpose of determining the class of respirator to be used, the employer shall measure, when possible, the atmospheric concentration of carbon tetrachloride in the workplace initially and thereafter whenever process, worksite, climate, or control changes occur which are likely to increase the carbon tetrachloride concentration. This requirement shall not apply when only supplied-air, positive pressure respirators will be used.

(B) The employer shall ensure that no worker is being exposed to carbon tetrachloride in excess of the environmental limit because of improper respirator selection, fit, use, or maintenance.

(C) The employer shall provide respirators in accordance with Table I-1 and shall ensure that the employee uses the respirator provided.

TABLE I-1  
 RESPIRATOR SELECTION GUIDE FOR PROTECTION  
 AGAINST CARBON TETRACHLORIDE

Concentrations of Carbon Tetrachloride	Respirator Type
20 ppm or less	1) Any supplied-air respirator. 2) Any self-contained breathing apparatus.
100 ppm or less	1) Any supplied-air respirator with a full facepiece, helmet or hood. 2) Any self-contained breathing apparatus with a full facepiece.
Greater than 100 ppm or entry and escape from unknown concentrations	1) Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. 2) 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	1) Any gas mask providing protection against organic vapors. 2) Any escape self-contained breathing apparatus.

(D) Respiratory protective devices described in Table I-1 shall be those approved under provisions of 30 CFR 11.

(E) Respirators specified for use in higher concentrations of carbon tetrachloride are permitted in atmospheres of lower concentrations.

(F) Chemical cartridges and canisters shall not be used with carbon tetrachloride except for evacuation or escape.

(G) The employer shall ensure that respirators are adequately cleaned, maintained, and stored, and that employees are instructed on the use of respirators and on testing for leakage.

(4) Where an emergency may develop that could result in employee injury from overexposure to carbon tetrachloride, the employer shall provide respiratory protection as listed in Table I-1.

(b) Protective Clothing

In any operation where the worker may come into direct contact with liquid carbon tetrachloride, protective clothing shall be worn. The clothing shall be both impervious and resistant to carbon tetrachloride. Gloves, boots, overshoes, and bib-type aprons (at least knee-length) shall be provided when necessary. Impervious supplied-air hoods or suits shall be worn when entering confined spaces such as pits or tanks unless known to be safe. In situations where heat stress is likely to occur, air-supplied suits shall be used. All protective clothing shall be well aired and inspected for defects prior to reuse.

(c) Eye Protection

Eye protection shall be provided for and worn by any employee engaged in an operation where carbon tetrachloride liquid or spray may

enter the eye. Chemical-type goggles, safety glasses with splash shields, or plastic face shields made completely of carbon tetrachloride-resistant materials shall be used. Suitable eye protection shall be in accordance with 29 CFR 1910.133.

#### Section 5 - Informing Employees of Hazards from Carbon Tetrachloride

All new and present employees in any carbon tetrachloride area shall be kept informed of the hazards, relevant symptoms, effects of overexposure, and proper conditions and precautions concerning safe use and handling of carbon tetrachloride.

A continuing educational program shall be instituted to ensure that all workers have current knowledge of job hazards, proper maintenance procedures, and cleanup methods, and that they know how to correctly use respiratory protective equipment and protective clothing.

The information explaining the hazards of working with carbon tetrachloride shall be kept on file and readily accessible to the worker at all places of employment where carbon tetrachloride is manufactured, used, transported, or stored.

Information as required shall be recorded on US Department of Labor Form OSHA-20, "Material Safety Data Sheet," or similar form approved by the Occupational Safety and Health Administration, US Department of Labor.



Section 6 - Work Practices

(a) Handling and Storage

(1) Storage containers, piping, and valves shall be periodically inspected for leakage.

(2) Storage facilities shall be designed to contain spills and prevent contamination of workroom air.

(b) Contaminant Controls

(1) Suitable engineering controls designed to limit exposure shall be designed to prevent the accumulation or recirculation of carbon tetrachloride in the workroom and to effectively remove carbon tetrachloride from the breathing zones of workers. Ventilation systems shall be subjected to regular preventive maintenance and cleaning to ensure maximum effectiveness, which shall be verified by periodic airflow measurements.

(2) Portable exhaust ventilation or suitable general ventilation shall be provided for operations that require the spray application of carbon tetrachloride such as in fumigation operations.

(c) Equipment Maintenance and Emergency Procedures

(1) Carbon tetrachloride hazard areas

Any space workers may enter where, because of its physical characteristics and sources of carbon tetrachloride, a volume of carbon tetrachloride could enter its atmosphere that would result in a vapor concentration in excess of the environmental limit, shall be considered a hazard area. Exits shall be plainly marked. Emergency exit doors shall be conveniently located and shall open into areas which will remain free of contamination in an emergency. At least 2 separate means of exit shall be

provided from each room or building in which carbon tetrachloride is stored or handled in quantities that could create a hazard.

(2) Confined spaces

(A) Entry into confined spaces or into other areas where there may be limited egress shall be controlled by a permit system. Permits shall be signed by an authorized representative of the employer certifying that preparation of the confined space, precautionary measures, personal protective equipment, and procedures to be used are all adequate.

(B) Tanks, pits, tank cars, process vessels, tunnels, sewers, grain storage bins, or other confined spaces, which have contained carbon tetrachloride shall be thoroughly ventilated to assure an adequate supply of oxygen, tested for carbon tetrachloride and other contaminants, and inspected prior to each entry. Ventilation shall be maintained while workers are in the space.

(C) Inadvertent infiltration of carbon tetrachloride into the confined space while work is in process inside shall be prevented by disconnecting and blanking off carbon tetrachloride supply lines.

(D) Confined spaces shall be ventilated to keep any carbon tetrachloride concentration below the standard and to prevent oxygen deficiency.

(E) Personnel entering confined spaces shall be furnished with appropriate personal protective equipment and protected by a lifeline tended by another worker outside the space, who shall also be equipped for entry with approved respiratory, eye, and skin protection, lifeline, and have contact with a third party.

(F) Written operating instructions and emergency medical procedures shall be formulated and posted in conspicuous locations where accidental exposure to concentrations of carbon tetrachloride which exceed the standard may occur. These instructions and procedures shall be printed both in English and in the predominant language of non-English-speaking workers, if any, unless they are otherwise trained and informed of the hazardous areas. Special instructions shall be given to illiterate workers.

(d) Showers and Eye Wash Fountains

Showers and eye wash facilities shall be provided and so located as to be readily accessible to workers in all areas where skin or eye splash with carbon tetrachloride is likely. If carbon tetrachloride is splashed on the skin, contaminated clothing shall be promptly removed and the skin washed with soap and water. If liquid carbon tetrachloride contacts the eyes, they shall be thoroughly irrigated with clean water, following which medical assistance shall be promptly provided. Such incidents shall be reported to the immediate supervisor by the affected employee or by a fellow worker.

Section 7 - Monitoring and Recordkeeping

(a) Where it has been determined that the environmental concentrations do not result in TWA workday exposures above one-half the TWA environmental limit, environmental monitoring shall not be required. However, records which form the basis for concluding that the exposures are below one-half the limit shall be maintained and exposure surveys shall be made when any process change indicates the need for reevaluation or at the discretion of the compliance officer.

(b) Where exposure concentrations have not been determined, they shall be determined within 6 months of the promulgation of a standard incorporating these recommendations.

(c) Where it has been determined that environmental concentrations result in TWA workday exposures above one-half the limit, employers shall maintain records of environmental exposures to carbon tetrachloride based upon the following sampling and recording schedules:

(1) Samples shall be collected at least quarterly in accordance with Appendix I for the evaluation of the work environment with respect to the recommended standard.

(2) Environmental samples shall be taken when a new process is installed or when process changes are made which may cause an increase in environmental concentrations. Increased production, relocation of existing operations, and increased overtime shall require resampling.

(3) In all monitoring, samples shall be collected which are representative of breathing-zone exposures characteristic of each job or specific operation in each work area. Sufficient numbers of samples shall be collected to express the variability of exposure for the work situation and to estimate TWA workday exposures for every employee.

(4) The minimum number of representative TWA exposure determinations for an operation or process shall be based on variation in exposures and production schedules considering the number of workers exposed as suggested in Table I-2 or as indicated by a professional industrial hygienist.

TABLE I-2

SAMPLING SCHEDULE

Number of Employees Exposed	Number of TWA Determinations
1 - 20	50% of the number of workers
21 - 100	10 plus 25% of the excess over 20 workers
more than 100	30 plus 5% of the excess over 100 workers

(d) When exposure levels are found to be greater than those prescribed in Section 1(a), environmental concentrations shall be reduced by suitable engineering controls. Exposures shall be monitored at least weekly until the effectiveness of the controls is established.

(e) All records of sampling and of pertinent medical examinations shall be maintained for at least 20 years after the individual's employment is terminated. Records shall indicate the type of personal protective devices, if any, in use at the time of sampling. Each employee shall have access to information on his own environmental exposure.

## 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 carbon tetrachloride. 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, after a review of data and consultations 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. It should be pointed out that any criteria and recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work environments and simply complying with the recommended standard should not be the final goal.

These criteria for a standard for carbon tetrachloride are part of a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of carbon tetrachloride 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 (1) protect workers against development of systemic effects, and against local effects on the skin and eyes, (2) be measurable by techniques that are valid, reproducible, and available to industry and governmental agencies, and (3) be attainable with existing technology.

Carbon tetrachloride in liquid, aerosol, or vapor forms can be detrimental to health. It is readily absorbed by the skin and gastrointestinal tract in liquid form and by the lungs as a mist or vapor. The effects of exposure vary from temporary illness and discomfort to permanent severe injury. The risk from carbon tetrachloride exposure may be increased by the use of alcohol or barbiturates.