

**NIOSH**

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

**CHLOROPRENE**



**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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TO**

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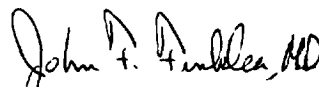
## PREFACE

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 chloroprene by members of the NIOSH staff and the valuable constructive comments by the Review Consultants on Chloroprene, by the ad hoc committees of the Society for Occupational and Environmental Health and the Society of Toxicology, 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 chloroprene. A list of Review Consultants appears on page vi.



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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for the development of the criteria and recommended standard for chloroprene. Donald M. Valerino, Ph.D., of this Division served as criteria manager. SRI International developed the basic information for consideration by NIOSH staff and consultants under contract CDC 99-74-31.

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The views expressed and conclusions reached in this document, together with the recommendations for a standard, are those of NIOSH. These views and conclusions are not necessarily those of the consultants, other federal agencies or professional societies that reviewed the document, or of the contractor.

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CRITERIA DOCUMENT:  
RECOMMENDATIONS FOR AN OCCUPATIONAL  
EXPOSURE STANDARD FOR CHLOROPRENE

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## I. RECOMMENDATIONS FOR A CHLOROPRENE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to chloroprene in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and provide for the 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 chloroprene on the health of employees and provide for their safety. Sufficient technology exists to permit compliance with the recommended standard. Although NIOSH considers the workplace environmental limit to be a safe level based on current information, the employer should regard it as the upper boundary of exposure and make every effort to maintain the exposure 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 occupational exposure to the chlorinated hydrocarbon monomer,  $\text{CH}_2:\text{C}(\text{Cl})\text{CH}:\text{CH}_2$ , hereinafter referred to as chloroprene. Synonyms for chloroprene include 2-chloro-1,3-butadiene, 2-chloroprene, and beta-chloroprene. The monomer is polymerized in a water solution, forming a polychloroprene latex also called neoprene latex. Neoprene historically was the trademark for polychloroprene latex and rubber products; the two names are now synonymous.

The primary hazards in the manufacture of chloroprene arise from inhalation of the vapor and skin contact with the liquid. The most important issues are whether chloroprene is a mutagen, a teratogen, or a

carcinogen in humans. It may cause adverse effects on the central nervous system (CNS), liver, cardiovascular system, and kidneys.

"Occupational exposure to chloroprene" is defined as work in any establishment where chloroprene is manufactured, stored, handled, used, or otherwise present. If exposure to other chemicals is likely, the employer shall also comply with any applicable standards for these other chemicals. "Emergency" is defined as any disruption in work process or practice, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which is likely to result in unexpected exposure to chloroprene in quantities that may cause physical harm. Occupational exposure to chloroprene shall require adherence to all the following sections.

#### Section 1 - Environmental (Workplace Air)

##### (a) Concentration

The employer shall control exposure to chloroprene so that no employee is ever exposed at a concentration greater than 3.6 milligrams per cubic meter (mg/cu m) of air (1 ppm), determined as a ceiling concentration for any 15-minute sampling period during a 40-hour workweek. The schedule for such sampling shall be determined by a professional industrial hygienist in accordance with good industrial hygiene practice.

##### (b) Sampling and Analysis

Samples of workplace air shall be collected and analyzed at least annually as described in Appendices I and II, or by any methods shown to be equivalent in accuracy, precision, and sensitivity to the methods specified.

Section 2 - Medical

(a) Placement examinations shall include at least:

(1) Comprehensive medical and work histories with special emphasis directed towards the skin, the eyes, and the hepatic, pulmonary, renal, and central nervous systems.

(2) Physical examination giving particular attention to the skin, eyes, and CNS function.

(3) Specific clinical tests, including at least urinalysis, a 14- x 17-inch posteroanterior chest roentgenogram, and pulmonary function tests such as the forced vital capacity (FVC) and the forced expiratory volume at one second (FEV 1). In addition, such tests as determination of serum glutamate-pyruvate transaminase (SGPT), electrocardiographs, and any others considered by the responsible physician to be useful in assessing possible deleterious effects on the employee's health should be used at the physician's discretion.

(4) Evaluation of the worker's ability to use positive pressure respirators.

(b) Periodic examinations shall be made available on at least an annual basis or at some other, lower frequency to be determined by the responsible physician. These examinations shall include at least:

(1) Interim medical and work histories

(2) Physical examination as outlined in 2(a)(1-3) above.

(c) During preplacement examinations, applicants or employees having medical conditions which would be directly or indirectly aggravated by exposure to chloroprene shall be counseled on the increased risk of impairment of their health from working with this substance. Employees who become pregnant shall be counseled that their continuing to work with chloroprene may have adverse effects on their pregnancies. All employees shall be advised of the value of periodic medical examinations. Workers shall be advised that chloroprene has shown antifertility effects on male rats and that testing with bacteria and fruit flies showed that it induced mutations. The relevance of these studies to male and female workers has not yet been established. High exposures have induced oligospermia in men. These findings indicate that both employers and employees should attempt to minimize exposure to chloroprene whenever possible.

(d) Initial medical examinations shall be made available to all employees as soon as practical after the promulgation of a standard based on these recommendations.

(e) In an emergency involving chloroprene, all affected personnel shall be provided with immediate first-aid services, especially with regard to the lungs and eyes. In the event of contact with chloroprene, any contaminated clothing and shoes shall be immediately removed and the skin washed with soap and water. If chloroprene contacts the eyes, they shall be immediately flushed with water for 15 minutes.

(f) Pertinent medical records shall be kept for all employees exposed to chloroprene in the workplace. Such records shall be kept 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, of the employer, and of the employee or former employee.

### Section 3 - Labeling and Posting

All the labels and warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Illiterate workers or workers reading languages other than those used on labels and posted signs shall receive information regarding hazardous areas and shall be informed of the instructions printed on labels and signs.

#### (a) Labeling

The following warning label shall be affixed in a readily visible location on processing or other equipment and storage tanks or containers which hold chloroprene either alone or as an incidental component of polychloroprene latex:

#### CHLOROPRENE

DANGER! FLAMMABLE!  
BREATHING VAPOR MAY BE HAZARDOUS TO HEALTH

Use only with adequate ventilation.  
Avoid breathing vapor.  
Avoid contact with skin.  
May generate toxic vapors on contact with heat or open flame.  
Keep containers closed when not in use.

First Aid: In case of skin contact, wash thoroughly with soap and water for at least 15 minutes. In case of eye contact, flush with water for at least 15 minutes. In case of eye contact or ingestion, consult a physician.

(b) Posting

The following warning sign shall be affixed in a readily visible location at or near entrances to areas in which there may be occupational exposure to chloroprene:

CHLOROPRENE

DANGER! FLAMMABLE!  
BREATHING VAPOR MAY BE HAZARDOUS TO HEALTH  
LIQUID BURNS SKIN

If respirators are required, the following statement shall be added in large letters to the sign required above:

RESPIRATORY PROTECTION REQUIRED IN THIS AREA

In any workplace or area where there is a likelihood of emergency situations arising, signs required by paragraph (b) of this section shall be supplemented by training sessions giving emergency and first-aid instructions and procedures, the locations of first-aid supplies and emergency equipment, and the locations of emergency showers and eyewash fountains.

Section 4 - Personal Protective Clothing and Equipment

The employer shall use efficient engineering controls and safe work practices to maintain exposure to chloroprene within the limit specified in Section 1(a) and shall provide protective equipment and clothing impervious to chloroprene (ie, vinyl- or rubber-coated material) to prevent skin and

eye contact. Emergency exits shall be located at clearly identified stations within the work area and shall be adequate to permit all employees to escape safely from the area. The employer shall provide eyewash fountains at locations convenient to, but not within, areas of possible exposure to chloroprene.

(a) Protective Clothing

(1) The employer shall provide face shields (8-inch minimum) with goggles and shall ensure that employees wear the protective equipment at any operation which affords a possibility of liquid chloroprene coming into contact with the eyes. Eye protective devices shall conform with 29 CFR 1910.133.

(2) The employer shall provide appropriate protective clothing for use in any operation where the worker has any possibility of coming into direct contact with liquid chloroprene. The clothing shall be both impervious and resistant to chloroprene. Gloves, boots, overshoes, and bib-type aprons that cover boot tops shall be provided when necessary. Impervious supplied-air hoods or suits shall be worn when entering confined spaces, such as pits or tanks, unless they are known to be safe. In situations where heat stress is likely to occur, air-supplied suits shall be used. All protective clothing shall be cleaned, well-aired, and inspected for defects prior to reuse.

(b) Respiratory Protection

(1) Engineering controls shall be used when needed to keep chloroprene concentrations at or below the permissible exposure limit. The only circumstances in which respiratory protective equipment may be used to restrict exposure of workers to chloroprene are:



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

(B) For operations such as maintenance and repair activities that may cause brief exposure at concentrations in excess of the occupational exposure limit.

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

(2) When a respirator is permitted by paragraph (b)(1) of this section, it shall be selected and used in accordance with the following requirements:

(A) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134. Employees shall be instructed in the proper use and testing for leakage of respirators assigned to them.

(B) To determine whether a respirator is needed in a nonemergency situation, the employer shall measure the atmospheric concentration of chloroprene in the workplace before it is entered by the appropriate workers and supervisors.

(C) The employer shall provide respirators in accordance with Table I-1 and shall ensure that employees use the respirators provided. The respiratory protective devices provided in conformance with Table I-1 shall be those approved by the Mining Enforcement and Safety Administration and NIOSH as specified under the provisions of 30 CFR 11.

TABLE I-1

RESPIRATOR SELECTION GUIDE FOR  
EXPOSURE TO CHLOROPRENE

---

Self-contained breathing apparatus with  
positive pressure in full facepiece

Combination supplied-air respirator,  
pressure-demand type, with auxiliary  
self-contained air supply

---

(D) When a self-contained breathing apparatus is selected, the employer shall provide initial training and monthly refresher courses on the use, maintenance, and function of the self-contained breathing apparatus.

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

Section 5 - Informing Employees of Hazards from Chloroprene

(a) Employees to be assigned to work in areas in which exposure to chloroprene is likely shall be informed by the employer prior to employment, and on a semiannual basis thereafter, of the hazards, relevant symptoms of overexposure, appropriate emergency procedures, and proper conditions and precautions to minimize chloroprene exposure. Employees engaged in maintenance and repair activities shall be included in these training programs. All employees shall be instructed about the availability of such information and its location. Records of such training shall be preserved to verify the frequency of training.

(b) The employer shall institute a continuing education program, conducted by persons qualified by experience or training, to ensure that all employees have current knowledge of job hazards, proper maintenance and cleanup methods, and proper respirator usage. The instructional program shall include a description of the general nature of the medical monitoring procedures and of the advantages to the employee of undergoing these examinations. As a minimum, instruction shall include oral presentation of the information in Appendix III, which shall be kept on file, readily accessible to employees at all places where exposure may occur.

(c) 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) Exhaust Ventilation Systems

Operations having the potential of producing occupational exposure to chloroprene shall be enclosed to the maximal extent practicable and provided with local exhaust ventilation, unless other methods of controlling the workplace airborne chloroprene concentration below the occupational exposure limit have been established. Motors for ventilation equipment and other items requiring external motive power shall be sparkproof. Effluent air shall be treated appropriately to enable it to meet any emission standards that may be promulgated and shall not be recirculated in the workplace.

Enclosures, exhaust hoods, and the associated ductwork shall be kept in good repair to contain vapors and maintain design airflows at hood faces

and within ducts. Airflows shall be measured at hood faces and inlets to ducts at least every 6 months and preferably monthly. Continuous airflow indicators, such as manometers containing light oil or another comparatively nonvolatile fluid, mounted to indicate airflow, are recommended. A record of design airflows and measurements made at least every 6 months at critical points of the exhaust system shall be kept in a permanent record book.

(b) Emergency Procedures

For all work areas where a reasonable potential for emergencies involving chloroprene exists, the employer shall take all necessary steps to ensure that employees are instructed in and follow the procedures specified below and any others appropriate for the specific operation or process and shall instruct employees in their implementation.

(1) Procedures shall include prearranged plans for obtaining emergency medical care and for transportation of injured employees. 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 personnel essential to emergency operations. Employees not essential to emergency operations shall be evacuated from hazardous areas where inhalation, ingestion, or direct skin or eye contact may occur. The perimeters of these areas shall be delineated, posted, and secured.

(3) Only personnel properly trained in the procedures and adequately protected against the attendant hazards shall shut off sources of chloroprene, clean up spills, and immediately repair all leaks.

(4) Any spills of chloroprene shall be cleaned up immediately.

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

(6) Portable fire extinguishers shall be placed in readily accessible locations and shall meet the requirements of 29 CFR 1910.157.

(7) Fires, if any arise, shall be extinguished with foam, carbon dioxide, dry-chemical, or other smothering devices.

(8) An alarm to signal evacuation of the plant under emergency conditions shall be installed in the plant and shall meet the requirements of 29 CFR 1910.163(a).

(c) Confined Spaces

(1) Entry into confined spaces or into other areas from which egress may be limited 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.

(2) Tanks, pits, tank cars, process vessels, tunnels, sewers, or other confined spaces that have contained chloroprene or polychloroprene (neoprene) shall be thoroughly ventilated to assure an adequate supply of oxygen, tested for chloroprene and other contaminants, and inspected prior to each entry. Ventilation shall be maintained while workers are in the confined space.

(3) Seepage of chloroprene into the confined space while work is in progress inside shall be prevented by disconnecting and blanking off chloroprene or latex supply lines.

(4) Personnel entering a confined space shall be furnished with appropriate personal protective equipment as specified in Section 4 above and protected by a lifeline tended outside the space by another worker who shall also be equipped for entry with approved respiratory, eye, and skin protection and a lifeline. These two workers shall be in constant communication. A third worker shall maintain general surveillance of the activities of the other two and shall be equipped appropriately to be able to enter the confined space if necessary.

(d) Handling and Storage

(1) Storage containers, piping, and valves shall be inspected periodically for leakage. Containers shall be stored in cool, well-ventilated areas and shall be kept away from peroxides and other oxidizing chemicals.

(2) Storage facilities shall be designed and sited to contain spills, to prevent contamination of workroom air, and to lessen the hazard from fire. The applicable provisions of 29 CFR 1910.106 shall be adhered to.

(3) Processes and storage facilities shall not be located near open flames or high-temperature operations.

(4) Where chloroprene is transferred from one metal container to another, the two vessels shall be grounded or electrically interconnected by bonding. This does not apply to transfers through piping. All mechanical equipment shall be of sparkproof construction.

(e) General Work Practices

(1) Prior to maintenance work, sources of chloroprene shall be shut off. The concentration of chloroprene in the air of the work area

shall be reduced to the extent feasible. If concentrations at or below the ceiling environmental air limit cannot be assured, respiratory protective equipment, as described in Section 4 of this chapter, shall be used during such maintenance work.

(2) Employees who have skin contact with chloroprene shall immediately wash or shower with soap and water for at least 15 minutes to remove all traces of chloroprene from the skin. Contaminated clothing shall be removed immediately and disposed of or cleaned before reuse.

#### Section 7 - Sanitation Practices

(a) Eating, drinking, and food preparation or dispensing (including vending machines) shall be prohibited in chloroprene work areas.

(b) Smoking shall be prohibited in areas where chloroprene is used, transferred, stored, or manufactured. Carrying of lighters, matches, and other sources of ignition into chloroprene-containing work areas shall be prohibited.

(c) Employees who handle chloroprene or equipment contaminated with chloroprene shall be instructed to wash their hands thoroughly with soap and water before using toilet facilities or eating.

(d) Waste material contaminated with chloroprene shall be disposed of in a manner not hazardous to employees. The disposal method must conform with applicable local, state, and federal regulations and must not constitute a hazard to the surrounding population or environment.

## Section 8 - Monitoring and Recordkeeping Requirements

As soon as possible after promulgation of a standard based on these recommendations, the employer shall conduct an industrial hygiene survey at each location where chloroprene is released into the workplace air to determine whether exposure to airborne chloroprene is in excess of the occupational exposure limit. The employer shall keep records of these surveys. If the employer concludes that concentrations of airborne chloroprene are at or below the occupational exposure limit, the records must state the basis for this conclusion. Surveys shall be repeated at least quarterly and within 30 days of any process change likely to result in an increase in airborne chloroprene concentrations. If the employer has determined that the environmental concentration of chloroprene in a workplace may exceed the occupational exposure limit, he shall fulfill the following requirements:

### (a) Personal Monitoring

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

(2) Routine monitoring of employee exposures shall be conducted at least quarterly.

(3) Samples representative of the exposure in the breathing zone of the employee shall be collected in all personal monitoring. Procedures for sampling, calibration of equipment, and analysis of chloroprene samples shall be as provided in Appendices I and II. Methods of comparable sensitivity, accuracy, precision, reliability, and ease of



performance may be substituted for those described in these appendices.

(4) For each determination of an occupational exposure concentration, a sufficient number of samples shall be taken to characterize the employee's exposure. Variations in the employee's work and production schedules, location, and duties shall be considered when samples are collected.

(5) The exposure of affected employees shall be monitored at least once every 3 months. In the event of overexposure, control measures shall be initiated and the employee shall be notified of the overexposure and of the control measures being instituted. Such monitoring shall continue until two determinations, at least 1 week apart, indicate that the employee's exposure no longer exceeds the recommended environmental limit; routine monitoring may then be resumed.

(b) Recordkeeping

Employers or their successors shall keep records of environmental monitoring for each employee for at least 30 years after the individual's employment has terminated. These records shall include the name of the employee being monitored, dates of measurements, duties and job locations within the worksite, sampling and analytical methods used and evidence of their accuracy, number and duration of samples, results of analyses, occupational exposure concentrations based on these samples, and personal protective equipment used by the employee. Records for each employee which indicate date of employment with the company and changes in job assignment shall be kept for the same 30-year duration. The employer shall make these records available on request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health or of the Director of

the National Institute for Occupational Safety and Health. Employees and former employees, or their authorized representatives, shall have access to information on their own exposures, and the employee or the employee's representative shall be given the opportunity to observe any measurement conducted in accordance with this section. Any observer shall have the right to an explanation of the procedures used, of the results of the measurements, and of the meaning of the results for human health and safety.

## II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon that were prepared to meet the need for preventing occupational disease or injury from workplace exposure to chloroprene. 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 and to provide for the safety of employees exposed to hazardous chemical and physical agents. Criteria for any recommended standard should enable management and labor to develop better engineering controls and more healthful work practices and should not be regarded as a final goal.

These criteria for a standard for chloroprene are part of a continuing series of documents developed by NIOSH. The recommended standard applies to workplace exposure to chloroprene arising from the processing, manufacture, and use of the substance, as in the production of polychloroprene latex, 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 against the development of both systemic effects and local effects on the skin and eyes, (2) be measurable down to the proposed ceiling concentration of chloroprene by techniques that are feasible, reproducible, and available to industry and government agencies, and (3) be attainable by using existing technology.

The primary hazards to health in chloroprene manufacture arise from inhalation of airborne chloroprene vapor and skin contact with the liquid. A major obstacle encountered in the preparation of this document was the paucity of pertinent information on human and animal toxicity. During the development of this criteria document, repeated attempts were made to contact foreign investigators for the purpose of acquiring additional information on their published data. Since these attempts were unsuccessful, it was not possible to confirm the validity of all the data and the significance of the conclusions referred to in this document. Consequently, proper scientific evaluation and interpretation of these articles could not be achieved.

There are many unanswered questions concerning the general toxicity of chloroprene. The mechanisms of the toxicity of chloroprene and its metabolites are unknown and should be investigated. Studies of chloroprene metabolism in the liver and lungs, the organs most susceptible at high exposure concentrations, are also needed. Mutagenic, carcinogenic, and reproductive effects must be further studied to clear up discrepancies in the current literature. Further epidemiologic and primate studies to ascertain a dose-response relationship are required. Validation of sampling and analytical procedures for concentrations of chloroprene below

those at which these methods have been validated by NIOSH will be carried out as soon as possible.