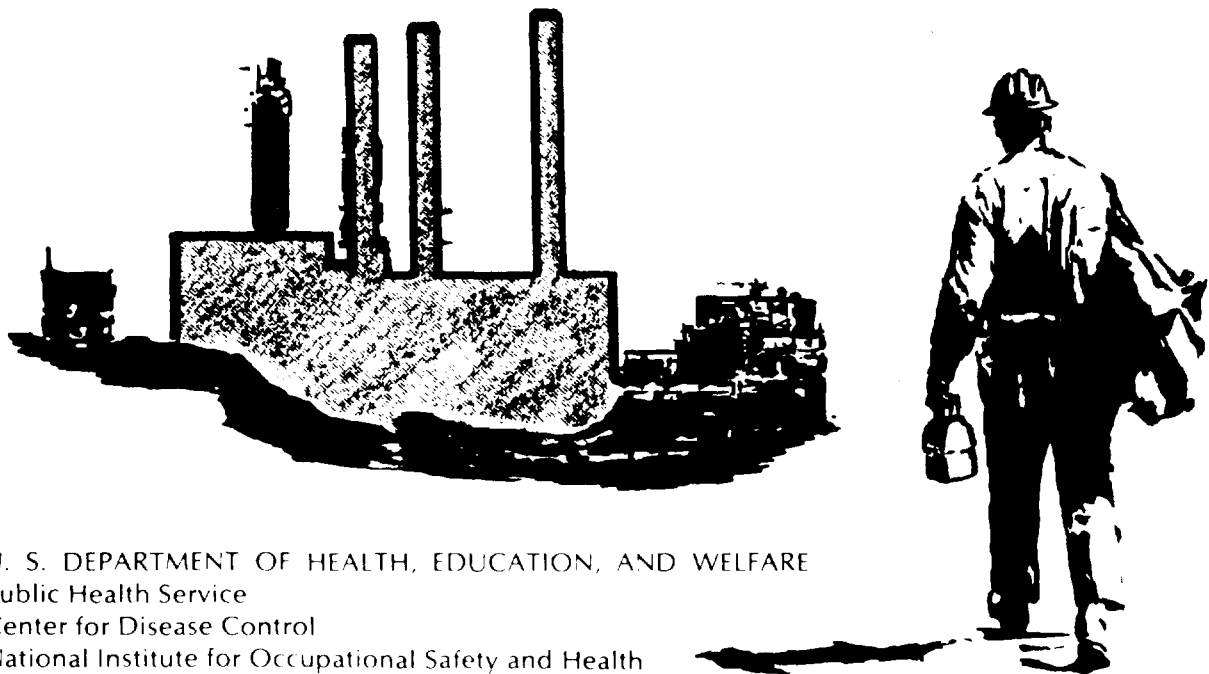


NIOSH

CRITERIA FOR A
RECOMMENDED STANDARD.....

OCCUPATIONAL
EXPOSURE TO

BENZYL CHLORIDE



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

criteria for a recommended standard....

**OCCUPATIONAL EXPOSURE
TO
BENZYL CHLORIDE**



**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
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National Institute for Occupational Safety and Health
AUGUST 1978**

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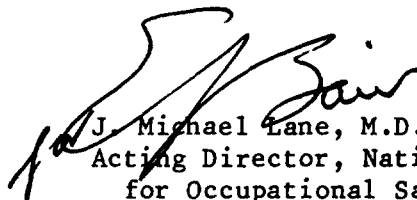
PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and provide for the safety of workers occupationally exposed to an ever-increasing number of potential hazards. The National Institute for Occupational Safety and Health (NIOSH) evaluates all available research data and criteria and recommends standards for occupational exposure. The Secretary of Labor will weigh these recommendations along with other considerations, such as feasibility and means of implementation, in promulgating regulatory standards.

NIOSH will periodically review the recommended standards to ensure continuing protection of workers and will make successive reports as new research and epidemiologic studies are completed and as sampling and analytical methods are developed.

The contributions to this document on benzyl chloride by NIOSH staff, other Federal agencies or departments, the review consultants, the reviewers selected by the Society of Toxicology, the American Industrial Hygiene Association, and the American Academy of Occupational Medicine, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, are gratefully acknowledged.

The views and conclusions expressed in this document, together with the recommendations for a standard, are those of NIOSH. They are not necessarily those of the consultants, the reviewers selected by professional societies, or other Federal agencies. However, all comments, whether or not incorporated, were considered carefully and were sent with the criteria document to the Occupational Safety and Health Administration for consideration in setting the standard. The review consultants and the Federal agencies which received the document for review appear on pages v and 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 benzyl chloride. Terence M. Grady of this Division served as criteria manager. Equitable Environmental Health, Inc. (EEH) developed the basic information for consideration by NIOSH staff and consultants under contract CDC 210-77-0148.

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I. RECOMMENDATIONS FOR A BENZYL CHLORIDE STANDARD

NIOSH recommends that employee exposure to benzyl chloride in the workplace be controlled by adherence to the following sections. The recommended standard is designed to protect the health and provide for the safety of employees for up to a 10-hour workshift, 40-hour workweek, over a working lifetime. Compliance with all sections of the recommended standard should prevent adverse effects of exposure to benzyl chloride on the health of employees and provide for their safety. The standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. 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 reviewed and revised as necessary.

These criteria and the recommended standard apply to exposure of employees to the chlorinated hydrocarbon $C_6H_5CH_2Cl$, hereinafter referred to as "benzyl chloride" in occupational environments. Synonyms for benzyl chloride include alpha-chlorotoluene, (chloromethyl) benzene, omega-chlorotoluene, and chlorophenylmethane. The major use of benzyl chloride is as an intermediate in organic synthesis. It has also been used as a high-pressure lubricant and was proposed for use as a war gas.

Benzyl chloride vapor and aerosol may irritate the skin, eyes, nose, and upper respiratory tract. The irritant properties provide sufficient warning such that employees do not voluntarily remain in areas of high (50 mg/cu m) concentrations. The odor of benzyl chloride, however, does not provide adequate warning of concentrations that may cause eye irritation. Direct contact of liquid benzyl chloride with the skin can cause burns. The recommended standard is designed to safeguard workers occupationally exposed to benzyl chloride from irritation of the eyes, skin, or mucous membranes and to reduce the risk of long-term systemic effects.

"Occupational exposure" to benzyl chloride is defined as work in any area where benzyl chloride is manufactured, processed, stored, handled, or used. Compliance with all sections of the recommended standard is required where there is occupational exposure to benzyl chloride. If benzyl chloride is handled or stored only in sealed, intact containers, eg, during shipment or storage, the recommended standard, except for Sections 3, 5(a), and 6(e), shall not apply. If exposure to other chemicals also occurs, provisions of any applicable standards for such other chemicals shall also apply.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Exposure to benzyl chloride shall be controlled so that no employee is exposed to benzyl chloride at a concentration greater than 5.0 milligrams per cubic meter (mg/cu m) determined as a ceiling concentration during any 15-minute sampling period.

(b) Sampling and Analysis

Workplace air samples shall be collected and analyzed as described in Appendix I, or by any method shown to be at least equivalent in precision, sensitivity, and accuracy.

Section 2 - Medical

Medical surveillance shall be made available as outlined below to all employees occupationally exposed to benzyl chloride.

(a) Preplacement medical examinations shall include at least:

(1) Comprehensive medical and work histories, with special emphasis directed to disorders of the respiratory system, skin, and eyes.

(2) A physical examination, with particular emphasis given to the respiratory system, skin, and eyes.

(3) A judgment of the worker's ability to use a positive pressure respirator.

(4) Specific clinical tests including at least a 14- x 17-inch posteroanterior chest roentgenogram, and tests of pulmonary function including forced expiratory volume during the 1st second (FEV₁) and forced vital capacity (FVC).

(b) Periodic examinations shall be made available at least annually to all employees occupationally exposed to benzyl chloride. These examinations shall include at least:

(1) Interim medical and work histories.

(2) Physical examination as described in (a)(2) and (a)(4) of this section, with the exception of the chest roentgenogram.

(c) Applicants or employees found during examinations to have medical conditions, such as emphysema, that could be aggravated directly or

indirectly by exposure to benzyl chloride shall be counseled as to the possibly increased risk of impairment of their health as a result of working with this substance.

(d) In the event of irritation or illness known or suspected to be due to exposure to benzyl chloride, appropriate medical services shall be made available.

(e) In an emergency involving massive exposure to benzyl chloride, either by inhalation or dermal contact, immediate medical attention and appropriate followup medical care shall be provided.

(f) Pertinent medical records shall be maintained for all employees occupationally exposed to benzyl chloride. Such records shall be kept for at least 30 years after termination of employment. Records of environmental exposures applicable to an employee shall be included with the employee's medical records. 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 warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Workers unable to read 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 process equipment, storage tanks, containers, or other facilities used for benzyl chloride:

BENZYL CHLORIDE

WARNING!
HIGHLY IRRITATING TO SKIN AND EYES
HARMFUL IF INHALED
CAN BE FATAL IF SWALLOWED

Use only with adequate ventilation.
Keep containers closed when not in use.
Wash hands thoroughly before eating, drinking, smoking, or using toilet.

First aid: If inhaled, remove to fresh air. Give artificial respiration if needed. Get medical attention.

In case of skin or eye contact: Immediately wash skin thoroughly or flush eyes with copious amounts of water. Get medical attention.

If swallowed: Induce vomiting immediately if patient is conscious. Get immediate medical attention.

(b) Posting

Areas in which benzyl chloride is present shall be posted with signs reading:

BENZYL CHLORIDE

WARNING!
HIGHLY IRRITATING TO SKIN AND EYES
HARMFUL IF INHALED
CAN BE FATAL IF SWALLOWED

Section 4 - Personal Protective Equipment and Clothing

(a) Eye and Face Protection

Safety glasses, chemical safety goggles, or face shields (20-cm minimum) with goggles shall be provided by the employer and shall be worn during any operation in which benzyl chloride may come in contact with the eyes (29 CFR 1910.133).

(b) Respiratory Protection

Engineering controls shall be used whenever needed to maintain airborne benzyl chloride concentrations at or below the recommended occupational exposure limits. Compliance with these limits by the use of respirators is permitted only during installation and testing of engineering controls, during performance of nonroutine maintenance or repair, when working in confined spaces, or during emergencies. When use of a respirator is permitted, it shall be selected and used in accordance with the following requirements:

(1) The employer shall ensure that no employee is exposed to benzyl chloride because of improper respirator selection, fit, use, or maintenance.

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

(3) The employer shall provide respirators in accordance with Table I-1 and shall require that the employee use the respirator provided when necessary.

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

(5) Respirators specified for use in atmospheres of higher concentrations of benzyl chloride may be used in atmospheres of lower concentrations.

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

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

(c) Protective Clothing

Protective clothing shall be resistant to penetration by, and to the chemical action of, benzyl chloride. Additional protection, including gloves, bib-type aprons, boots, or overshoes, shall be provided for, and worn by, each employee wherever there may be direct contact with liquid benzyl chloride. Supplied-air hoods or suits resistant to penetration by benzyl chloride shall be worn when entering confined spaces, such as pits or storage tanks. In situations where heat stress is likely to occur, supplied-air suits, preferably cooled, are recommended. The employer shall ensure that all personal protective clothing is inspected regularly for defects and is maintained in a clean and satisfactory condition. Protective equipment suitable for emergency use shall be located at clearly identified stations outside the work area.

Section 5 - Informing Employees of Hazards from Benzyl Chloride

(a) All new and present employees working with benzyl chloride shall be informed orally and in writing of the hazards, relevant signs and symptoms of exposure, appropriate emergency procedures, and proper conditions and precautions concerning safe use and handling of benzyl chloride. First-aid procedures shall be included. This information shall be readily available to all employees involved in the manufacture, use, transport, or storage of benzyl chloride and shall be posted in prominent positions within the workplace.

(b) Employers shall institute a continuing education program to ensure that all new and present employees subject to occupational exposure to

TABLE I-1

RESPIRATOR SELECTION GUIDE FOR BENZYL CHLORIDE

Concentration	Respirator Type Approved under Provisions of 30 CFR 11
Less than or equal to 50 mg/cu m	(1) Supplied-air respirator with full facepiece, helmet, or hood (2) Self-contained breathing apparatus with full facepiece
Less than or equal to 10,000 mg/cu m	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode or with full facepiece, hood, or helmet operated in continuous-flow mode
Greater than 10,000 mg/cu m or emergency (entry into area of unknown concentration)	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination respirator that includes Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode (3) Supplied-air suits may be necessary
Firefighting	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode

benzyl chloride have current knowledge of job hazards, maintenance procedures, cleanup methods, emergency procedures, and evacuation procedures. This program shall include at least:

- Emergency procedures and drills.
- Instruction in handling spills and leaks.
- Decontamination procedures.
- Location and use of firefighting equipment.
- First-aid procedures, equipment location, and use.
- Rescue procedures.
- Confined space entry procedures.
- Warning concerning inadequacy of odor as a means of detecting low concentrations that may cause eye irritation.

Such training shall be conducted at least annually, and records of such training shall be kept for at least 1 year.

(c) Information, as required, shall be recorded on the Material Safety Data Sheet shown in Appendix II, or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices

(a) Emergency Procedures

For all work areas where there is a likelihood that emergencies may occur, the employer shall take all necessary steps to ensure that employees are instructed in, and follow, the procedures specified below and any other procedures appropriate to the specific operation or process.

(1) Emergency procedures shall include at least prearranged plans for:

(A) Immediate evacuation, transportation, and medical assistance for affected employees; this procedure should include alerting medical treatment facilities of the impending arrival of affected employees.

(B) Designation of medical receiving facilities.

(C) Reentry into areas where benzyl chloride leaks or spills have occurred for cleanup, decontamination, or maintenance purposes.

(2) Personal protective equipment and clothing as specified in Section 4 shall be used by trained personnel essential to emergency operations.

(3) Nonessential employees shall be evacuated from hazardous areas during emergencies. Perimeters of these areas shall be posted and secured.

(4) Only trained personnel shall shut off sources of benzyl chloride, and only those protected against the attendant hazards shall clean up spills, control and repair leaks, and fight fires.

(5) Firefighting procedures shall be established for areas where flammable materials are used with benzyl chloride. Chemical foam, carbon dioxide, dry chemicals, or water spray or fog shall be used for fighting fires in areas where benzyl chloride is present. Protective equipment and clothing appropriate to the hazard shall be worn by all personnel in the area until concentrations of airborne benzyl chloride have been demonstrated by monitoring to be at or below the recommended occupational exposure limit.

(6) Showers, eyewash fountains, and washroom facilities shall be provided and be readily accessible to workers in all areas where skin or eye contact with liquid benzyl chloride is likely. If liquid benzyl chloride is splashed on the clothing or skin, contaminated clothing shall be promptly removed and the skin washed thoroughly with soap and water. If liquid benzyl chloride gets into the eyes, they shall be irrigated immediately with copious quantities of running water.

(7) Medical attention shall be provided promptly for any affected worker. Such exposures shall be reported to the immediate supervisor by the affected worker or by a fellow employee.

(b) Control of Airborne Benzyl Chloride

(1) Appropriate engineering controls designed to limit exposure to benzyl chloride to that prescribed in Section 1(a) shall be used. The use of completely enclosed processes is the recommended method of control for benzyl chloride. Local exhaust ventilation may also be effective, used alone or in combination with process enclosure. When a local exhaust ventilation system is used, it shall be designed to prevent the accumulation or recirculation of contaminated air in the occupational environment, to maintain benzyl chloride concentrations below the recommended limit, and to remove benzyl chloride from the breathing zones of employees. Exhaust systems discharging into outside air must conform with applicable local, state, and Federal air pollution regulations. Ventilation systems shall be subjected to regular preventive maintenance and cleaning to ensure effectiveness, which shall be verified by periodic airflow measurements at least every 3 months. Measurements of system efficiency shall also be made immediately by personnel properly attired in specified protective equipment when any change in production, process, or control might result in increased concentrations of airborne benzyl

chloride. Tempered makeup air shall be provided to work areas in which exhaust ventilation is operating.

(2) Forced-draft ventilation systems shall be equipped with remote manual controls and shall be designed to turn off automatically in the event of a fire in the work area.

(c) Handling of Benzyl Chloride and General Work Practices

(1) Employers shall ensure that safety showers, eyewash fountains, and other emergency equipment are in proper working order through regularly scheduled inspections performed by qualified maintenance personnel.

(2) Personnel attired in appropriate protective clothing and wearing protective equipment shall perform frequent inspections of operating systems to detect any leaks of benzyl chloride. All 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 benzyl chloride has been introduced into the system.

(3) Leaks shall be corrected as soon as possible after their detection.

(4) When benzyl chloride containers are being moved or when they are not in use and are disconnected, valve protection covers shall be in place. Containers shall be moved only with the proper equipment and shall be secured to prevent dropping or loss of control while being moved.

(5) Process valves and pumps shall be readily accessible and shall not be located in pits and congested areas.

(6) Containers and systems shall be handled and opened carefully. Approved protective clothing and devices as specified in Section 4 shall be worn while opening, connecting, and disconnecting benzyl chloride containers and systems. Adequate ventilation shall be available to prevent exposure to benzyl chloride when opening containers and systems.

(d) Work Areas

(1) Benzyl Chloride Work Areas

Exits shall be plainly marked and shall open outwardly. Emergency exit doors shall be conveniently located and shall open into areas from which escape is practical.

(2) Confined or Enclosed Spaces

Entry into confined spaces, such as tanks, pits, process vessels, tank cars, sewers, or tunnels, where there may be limited egress, shall be controlled by a permit system. Permits shall be signed by an authorized employer representative certifying that preventive and protective measures have been followed.

Confined spaces that have contained benzyl chloride shall be thoroughly ventilated to ensure an adequate supply of oxygen, tested for benzyl chloride and other contaminants, and inspected for compliance with these requirements before each entry. Adequate ventilation shall be maintained while an employee or other individual is in the space. Leakage of benzyl chloride or other contaminants into the confined space while work is in progress shall be prevented by disconnecting and blanking the supply lines for benzyl chloride and other materials. Individuals entering confined spaces shall be furnished appropriate personal protective clothing and devices and protected by a lifeline harness tended by another employee outside the space who also shall be equipped with personal protective clothing and devices approved for entry. Communication (visual, voice, signal line, telephone, radio, or other suitable means) shall be maintained by the standby person with the employee inside the confined or enclosed space.

(e) Storage

(1) Storage facilities shall be designed to contain spills completely within a surrounding dike and to prevent contamination of workroom air.

(2) Storage of benzyl chloride in contact with reactive metals, such as iron, copper, or aluminum, or in the vicinity of combustibles shall be prohibited.

(3) Benzyl chloride shall be stored in tightly closed containers in a well-ventilated area away from excessive heat and sunlight.

(4) Storage containers shall be periodically inspected for leakage.

(5) Ventilation control switches and emergency respiratory equipment shall be located outside storage areas in readily accessible locations.

(f) Spills, Leaks, and Waste Disposal

(1) If benzyl chloride leaks or spills, the following steps shall be taken:

(A) Evacuate all nonessential personnel from the area.

(B) Adequately ventilate the area of the spill or leak to prevent accumulation of the vapor.

(C) Collect spilled material for reclamation or absorb in vermiculite, dry sand, earth, or similar nonreactive material.

(2) Personnel entering the spill or leak area shall be furnished with appropriate personal protective equipment. All other personnel shall be excluded from the area.

(3) All wastes and residues containing benzyl chloride shall be collected in benzyl chloride-resistant containers and incinerated or buried in such a manner that no benzyl chloride or other toxic products are released to the environment. Prior to disposal, liquid benzyl chloride wastes may be hydrolyzed with alkalis such as lime, soda ash, or sodium bicarbonate to prevent adverse effects on receiving waters or treatment plants.

Section 7 - Sanitation Practices

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

(b) Appropriate locker rooms shall be available for changing into required protective clothing in accordance with 29 CFR 1910.141(e). Clothing contaminated with liquid benzyl chloride shall be immediately removed and placed in a sealed container for later disposal or decontamination. Employers shall require personnel who work with benzyl chloride to shower before leaving the workplace at the end of a workshift.

(c) Employers shall ensure that employees who handle benzyl chloride wash their hands thoroughly with soap and water before eating, smoking, or using toilet facilities.

(d) The storage, dispensing, preparation, and consumption of food, beverages, or tobacco shall be prohibited in benzyl chloride work areas.

(e) The employer shall ensure that plant personnel who launder and clean clothing or equipment contaminated with benzyl chloride are provided adequate personal protective equipment to prevent exposure and shall ensure that these employees are aware of the potential hazards of exposure to benzyl chloride. If an outside laundry facility is used, the launderers shall be advised of the hazards and proper procedures for handling contaminated work clothing. If contaminated clothing is to be transported to a laundry outside of the plant, it shall be placed in sealed containers.

Section 8 - Monitoring and Recordkeeping Requirements

(a) Employers shall determine by industrial hygiene survey whether exposure to airborne benzyl chloride is in excess of the recommended occupational exposure limit. Records of these surveys shall be kept, and if an employer concludes that air levels are at or below the recommended ceiling limit, the records must show the basis for this conclusion. Such surveys shall be repeated at least once every 12 months and within 30 days of any process change likely to result in an increase in the concentration of airborne benzyl chloride. When an industrial hygiene survey demonstrates that the concentration of benzyl chloride exceeds the recommended ceiling limit, the following requirements shall apply:

(b) Personal Monitoring

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

(2) In all personal monitoring, samples representative of the exposure to benzyl chloride in the breathing zone of the employee shall be collected. Procedures for sampling and analysis of benzyl chloride shall be in accordance with Section 1(b).

(3) For each ceiling concentration determination, a sufficient number of samples shall be taken to characterize employee exposures during each workshift. 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 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 ceiling limit, the exposure of that employee shall be measured at least once every week, 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 permissible exposure limit. Quarterly monitoring shall then be resumed.

(c) Recordkeeping

Records of environmental monitoring shall be kept for at least 30 years. These records shall include the dates and times of measurements; duties and location of the employees within the worksite; sampling and analytical methods used; number, duration, and results of the samples taken; ceiling concentrations estimated from these samples; type of

personal protective equipment used, if any; and employees' names. These records shall be made available to designated 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 that were prepared to meet the need for preventing disease or injury arising from occupational exposure to benzyl chloride. 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."

After reviewing data and consulting with others, NIOSH formalized a system for the development of criteria on which standards can be established to protect the health and provide for the safety of employees exposed to hazardous chemical and physical agents. The criteria and recommended standards should enable management and labor to develop better engineering controls resulting in more healthful work environments, and simply complying with the recommended standards should not be the final goal.

The criteria and recommended standard for benzyl chloride are part of a continuing series of documents published by NIOSH. The proposed standard applies to the manufacturing, processing, storage, and use of benzyl chloride or to other sources of exposure. The standard was not designed for the population-at-large, and any extension beyond the occupational environment is not warranted. It is intended to: (1) protect against the development of short- and long-term adverse systemic effects; (2) protect against local effects on the skin, eyes, and mucous membranes; (3) be measurable by techniques that are valid, reproducible, and available to industry and government agencies; and (4) be attainable with existing technology.

The development of these criteria for the recommended standard has demonstrated a need for further research in the following areas: (1) epidemiologic studies of the long-term health effects of exposure to benzyl chloride at concentrations bracketing the environmental limit; (2) animal studies designed to determine the cumulative effects from dermal contact with or inhalation of benzyl chloride; and (3) well-designed animal studies to investigate any carcinogenic, mutagenic, teratogenic, or reproductive effects produced by inhalation of, or dermal contact with, benzyl chloride.