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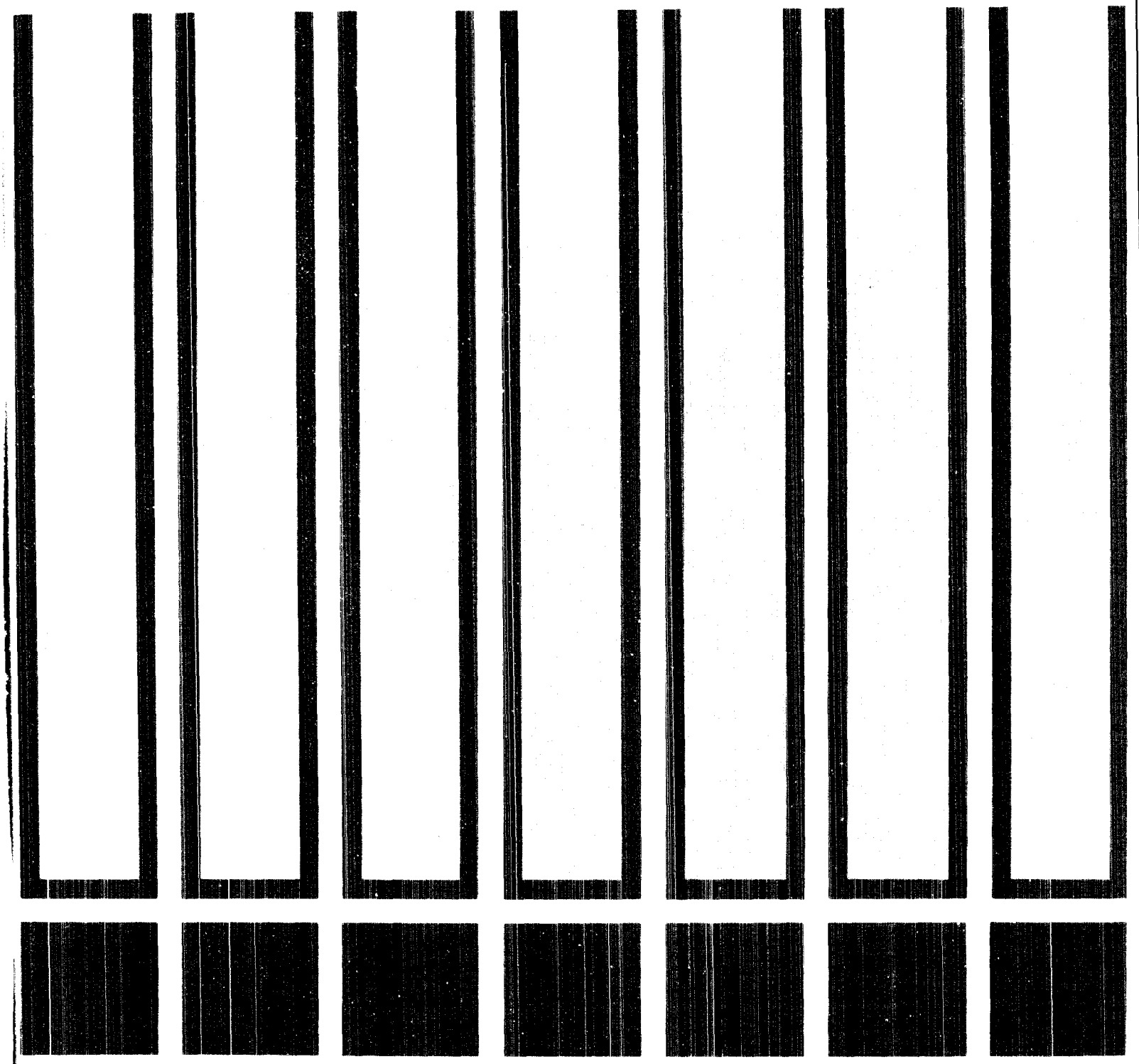

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service / Center for Disease Control
National Institute for Occupational Safety and Health

criteria for a recommended standard....

OCCUPATIONAL EXPOSURE TO

ALLYL CHLORIDE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
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CRITERIA DOCUMENT:
RECOMMENDATIONS FOR AN OCCUPATIONAL
EXPOSURE STANDARD FOR ALLYL CHLORIDE

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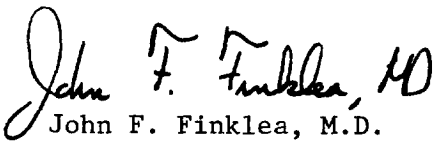
PREFACE

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 contribution to this report on allyl chloride by members of my staff and the valuable constructive comments by the Review Consultants on Allyl Chloride, by the ad hoc committee of the American Industrial Hygiene Association, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine. The NIOSH recommendations for standards are not necessarily a consensus of all the consultants and

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



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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for allyl chloride. The Division review staff for this document consisted of Herbert E. Christensen, D.Sc., Howard L. McMartin, M.D., and Douglas L. Smith, Ph.D., with Hervey B. Elkins, Ph.D., (consultant) and Seymour D. Silver, Ph.D., (consultant).

Stanford Research Institute developed the basic information for consideration by NIOSH staff and consultants under contract No. CDC-99-74-31. Sonia Berg had NIOSH program responsibility and served as criteria manager.

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I. RECOMMENDATIONS FOR AN ALLYL CHLORIDE STANDARD

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

"Allyl chloride" is the common synonym for the compound 3-chloropropene, also referred to as 3-chloro,1-propene. Other synonyms appear in Table XI-1. The term allyl chloride will be used throughout this document. The recommendations in this chapter apply to all places of employment where allyl chloride is manufactured, used, stored, or handled and where employees may be exposed by dermal or eye contact, inhalation, or ingestion. "Overexposure" to allyl chloride vapor is defined as known or suspected exposure above the time-weighted average (TWA) environmental level or ceiling limit. If exposure to other chemicals also occurs, for

example from contamination of epichlorohydrin with allyl chloride, provisions of any applicable standards for the other chemicals also shall apply. The "action level" is defined as half the recommended TWA environmental limit. When environmental concentrations are at or below the action level, adherence to Section 8 (a) and (b) is not required. "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 allyl chloride vapor or liquid in quantities which may cause physical harm.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Exposure to allyl chloride vapor shall be controlled so that employees are not exposed at a concentration greater than 1.0 part per million parts of air (ppm) by volume (approximately 3.1 mg/cu m of air) determined as a TWA concentration for up to a 10-hour workday in a 40-hour workweek, or at a ceiling concentration of 3.0 ppm (9.4 mg/cu m) for any 15-minute sampling period.

(b) Sampling, Collection, and Analysis

Procedures for collection and analysis of environmental samples shall be as provided 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

Medical surveillance, as outlined below, shall be made available to employees subject to exposure to allyl chloride.

(a) Preplacement examinations shall include at least:

(1) Comprehensive medical and work histories with special emphasis directed toward the respiratory system, liver, kidneys, skin, and eyes.

(2) A physical examination.

(3) Specific clinical tests, including, but not limited to, a 14- x 17-inch chest x-ray, pulmonary function tests including the forced vital capacity (FVC) and the 1-second forced expiratory volume (FEV 1), a complete blood count, a complete urinalysis with microscopic examination, and liver function tests, including at least serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) determinations.

(4) An evaluation of the employee's ability to use negative or positive pressure respirators.

(b) Periodic examinations shall be made available at least annually. These examinations shall include at least:

(1) Interim medical and work histories.

(2) Liver function tests and urinalyses as described for the preplacement examination.

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

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

(e) In the event of an overexposure to allyl chloride vapor, a physical examination, liver function tests, urinalysis, and pulmonary function tests as described for preplacement examinations, as well as other tests as determined by the attending physician, shall be made available within a reasonable period of time. If contact with the liquid has occurred, skin and eye irritation shall also be considered in the examination.

(f) In an emergency involving allyl chloride, all affected personnel shall be provided with immediate first-aid services, especially with regard to the respiratory tract, skin, and eyes. In the event of skin or eye contact with liquid allyl chloride, immediately flush eyes and skin with water for at least 15 minutes. Contaminated clothing and shoes shall be removed. In all cases of eye contact or inhalation of vapor causing marked irritation of the nose or throat, a physician shall be consulted. Because of the possibility of delayed reactions in the lungs and eyes, persons so exposed to allyl chloride shall be observed for a minimum of 24 hours following exposure. Tests as described in paragraph (e) of this section should be made available as warranted by results of the 24-hour observation period.

(g) Pertinent medical records shall be maintained for all employees exposed to allyl chloride in the workplace. Such records shall be kept for at least 20 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

(a) Labeling

Containers of allyl chloride shall carry a label stating:

ALLYL CHLORIDE

(3-CHLOROPROPENE)

HIGHLY FLAMMABLE

DANGEROUS IF INHALED OR SWALLOWED

ABSORBED THROUGH SKIN

IRRITATING TO SKIN AND EYES

Keep away from heat, sparks, and open flames.
In case of fire, use foam, dry chemical, or carbon dioxide fire extinguisher.
Avoid contact with eyes, skin, and clothing.
Keep container closed.
Use with adequate ventilation.

First aid: In case of skin or eye contact, immediately flush affected area with water for at least 15 minutes. Consult physician.

(b) Posting

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

ALLYL CHLORIDE

HIGHLY FLAMMABLE

DANGEROUS IF INHALED OR SWALLOWED

ABSORBED THROUGH SKIN

IRRITATING TO SKIN AND EYES

Avoid heat, sparks, or open flames.
No smoking permitted.
In case of fire, use fire extinguishers located at (location).
Avoid breathing vapor.
Avoid contact with skin, eyes, and clothing.
Provide adequate ventilation.

First aid: In case of skin or eye contact, immediately flush affected area with water for at least 15 minutes. Consult physician.

This warning sign shall be printed both in English and in the predominant language of non-English-reading employees. All employees shall be trained and informed of the hazardous areas with special instructions for illiterate employees.

Section 4 - Personal Protective Equipment

(a) Respiratory Protection

(1) Engineering controls shall be used to maintain allyl chloride vapor concentrations below the permissible exposure limits. Compliance with the permissible exposure limits may be achieved by the use of respirators only:

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

(B) For nonroutine operations, such as maintenance or repair activities, in which concentrations in excess of the permissible exposure limits may occur.

(C) During emergencies when air concentrations of allyl chloride may exceed the permissible limits.

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

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

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

TABLE I-1

RESPIRATOR SELECTION GUIDE

Air Concentration	Respirator Type
Less than or equal to 50 ppm	(1) Any supplied-air respirator with full facepiece operated in demand (negative pressure) mode (2) Any self-contained breathing apparatus with full facepiece operated in demand mode (3) In instances where brief exposures, 5 minutes or less, are encountered, a gas mask, full facepiece with chin-style, front- or back-mounted organic vapor canister may be used.
Less than or equal to 300 ppm (concentration considered to be immediately dangerous to life or health)	(1) Type C supplied-air respirator with full facepiece operated in continuous-flow or pressure-demand (positive pressure) mode (2) Type C supplied-air respirator with hood, helmet, or suit
Greater than 300 ppm (with impermeable protective clothing)	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece operated in the pressure-demand mode and an auxiliary self-contained air supply
Emergency (entry into an area of unknown concentration for emergency purposes, eg, firefighting; worn with impermeable protective clothing)	(1) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode (2) Combination Type C supplied-air respirator with full facepiece operated in the pressure-demand mode and an auxiliary self-contained air supply
Escape (from an area of unknown concentration)	(1) Gas mask, full facepiece, with front- or back-mounted organic vapor canister (2) Self-contained breathing apparatus with full facepiece operated in either the demand or pressure-demand mode

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

(b) Eye Protection

Full-facepiece respirators or chemical safety goggles shall be provided and worn for operations in which allyl chloride may splash into the eyes. Face shields may be used to augment chemical safety goggles where full facial protection is needed, but face shields, used alone, are not adequate for eye protection. Eye protection shall be selected and used in accordance with 29 CFR 1910.133.

(c) Skin Protection

Appropriate protective apparel, including gloves, aprons, suits, boots, or face shields (8-inch minimum) shall be provided and worn where needed to prevent skin contact with liquid allyl chloride. Protective apparel shall be made of materials which most effectively prevent skin contact under the conditions for which it is deemed necessary. Since leather articles cannot be effectively decontaminated, they shall be prohibited for use as protective apparel. Rubber articles may be used provided care is taken to ensure that permeation does not occur during usage. Protective apparel should be discarded at the first sign of deterioration.

Section 5 - Informing Employees of Hazards from Allyl Chloride

(a) Each employee subject to allyl chloride exposure shall be informed at the beginning of his employment or assignment to an allyl chloride area, and on an annual basis thereafter, of the hazards, relevant

symptoms, appropriate emergency procedures, and proper conditions and precautions for the safe use of allyl chloride. People engaged in maintenance and repair shall be included in these training programs. Each employee shall be instructed about the availability of such information which shall be kept on file. Information kept on file shall include that prescribed in paragraph (b) of this section and shall be accessible to the worker at each place of employment where allyl chloride is present.

(b) Information as required 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) Emergency Procedures

For all work areas where a reasonable potential for emergencies exists, the procedures specified below and any others appropriate for a specific operation or process shall be formulated in advance, and employees shall be instructed in their implementation.

(1) Procedures shall include prearranged plans for obtaining emergency medical care and for transportation of injured workers. These plans shall be reviewed by a responsible physician to ensure the adequacy of medical procedures and of training of first-aid personnel.

(2) Firefighting procedures shall be established and implemented. These shall include procedures for emergencies involving the release of allyl chloride vapor or its combustion products. In case of fire, allyl chloride sources shall be shut off or removed. Chemical foam, carbon dioxide, or dry chemicals shall be used for fighting allyl chloride

fires, and proper respiratory protection and protective clothing shall be worn.

(3) Approved eye, skin, and respiratory protection as specified in Section 4 shall be used by personnel essential to emergency operations.

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

(5) An emergency communication system shall be instituted and employees informed of its proper usage.

(6) Employees not essential to emergency operations shall be evacuated from exposure areas during emergencies. Perimeters of areas of hazardous exposures shall be delineated, posted, and secured.

(7) Only personnel properly equipped, trained in the procedures, and adequately protected against the attendant hazards shall shut off sources of allyl chloride, clean up spills, and repair leaks. All leaks shall be repaired immediately.

(8) Any spills of allyl chloride shall be cleaned up promptly by flushing with water or absorbing with materials such as vermiculite. Care shall be taken to prevent accumulation of explosive concentrations of allyl chloride vapor.

(b) Control of Airborne Allyl Chloride

Engineering controls, such as process enclosure or local exhaust ventilation, shall be used to maintain allyl chloride vapor concentrations within the recommended environmental limits. All such control equipment shall meet the requirements of subpart S of 29 CFR 1910 for hazardous locations. Ventilation systems shall be designed to prevent the

accumulation or recirculation of allyl chloride vapor in the workplace and to effectively remove allyl chloride vapor from the breathing zones of employees. Exhaust ventilation systems discharging into outside air must conform with applicable local, state, and federal air pollution regulations and must not constitute a hazard. Ventilation systems shall be subject to regular preventive maintenance and cleaning to ensure effectiveness, which shall be verified by airflow measurements taken at least quarterly.

(c) Storage

Containers of allyl chloride shall be kept tightly closed at all times when not in use. Because allyl chloride is a Class IB flammable liquid, containers shall be stored in accordance with the applicable provisions of 29 CFR 1910.106 and shall be protected from heat, mechanical damage, and sources of ignition. Allyl chloride shall be stored so as not to come in contact with strong oxidizers, acids, aluminum, zinc, amines, peroxides, chlorides of iron or aluminum, and other materials which react with allyl chloride.

(d) Handling and General Work Practices

(1) Use of allyl chloride as a maintenance solvent shall be prohibited.

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

(3) All piping systems and any equipment or metallic materials used in the transfer of allyl chloride must be electrically

bonded and grounded.

(4) An employee whose skin becomes contaminated with liquid allyl chloride shall immediately wash or shower to remove all traces of allyl chloride from the skin. Clothing contaminated with the liquid shall be cleaned before reuse or disposed of. Some materials which cannot be effectively decontaminated, such as leather, shall be discarded.

(e) Waste Disposal

Waste material contaminated with liquid allyl chloride shall be disposed of in a manner not hazardous to employees. Incineration, properly conducted to prevent the hazardous release of combustion products such as hydrochloric acid, may serve as a means of disposal.

(f) Confined Spaces

(1) Confined spaces which have contained allyl chloride shall be thoroughly ventilated, cleaned, neutralized, washed, inspected, and tested for oxygen deficiency and for allyl chloride and other contaminants prior to entry.

(2) Entry into confined spaces, such as tanks, pits, tank cars, barges, process vessels, and tunnels, shall be controlled by a permit system. Permits signed by an authorized representative of the employer shall certify that preparation of the confined space, precautionary measures, and personal protective equipment are adequate and that precautions have been taken to ensure that prescribed procedures will be followed.

(3) Individuals entering confined spaces where they may be exposed to allyl chloride shall wear a respirator as outlined in Section 4 and suitable harnesses with lifelines tended by another employee outside

the space who shall also be equipped with the necessary protective equipment.

(4) Accidental exposure to allyl chloride in confined spaces shall be prevented by disconnecting and blocking off allyl chloride supply lines.

(5) Confined spaces shall be ventilated while work is in progress to keep the concentration of any allyl chloride present below the workplace environmental limits and to prevent oxygen deficiency.

Section 7 - Sanitation

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

(b) Employees who handle liquid allyl chloride shall be instructed to wash their hands thoroughly with soap or mild detergent and water before eating or using toilet facilities.

(c) Smoking shall be prohibited in areas where allyl chloride is used, transferred, stored, or manufactured.

Section 8 - Environmental Monitoring and Recordkeeping

Within 6 months of the promulgation of this standard, each employer, who has a place of employment in which allyl chloride vapor is released into the workplace air, shall determine by an industrial hygiene survey if exposure to airborne concentrations of allyl chloride above the action level may occur. Records of these surveys, including the basis for concluding that air levels are at or below the action level, shall be

maintained. Surveys shall be repeated at least once every 3 years and within 30 days of any process change likely to result in an increase of airborne allyl chloride concentrations. If it has been decided that the environmental concentration of allyl chloride vapor may exceed the action level, TWA environmental limit, or the ceiling level, then the following requirements shall apply:

(a) Personal Monitoring

(1) A program of personal monitoring shall be instituted to identify and measure, or permit calculation of, the exposure of all employees occupationally exposed to allyl chloride vapor above the action level. Source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of the exposure in the breathing zone of the employee shall be collected. Procedures for sampling, calibration of equipment, and analysis of allyl chloride samples shall be as provided in Section 1(b).

(3) For each TWA determination, a sufficient number of samples shall be taken to characterize the employee's exposure during each workshift. Variations in work and production schedules shall be considered in deciding when samples are to be collected. The number of representative TWA determinations for an operation or process shall be based on the variations in location and job functions of employees relative to that operation or process.

(4) Employees shall be observed along with the operation or process to determine when maximum exposure is expected. One or more 15-minute samples taken during the time of such maximum exposure shall be used

to determine the actual ceiling concentration to which an employee is exposed.

(5) If an employee is exposed above the action level, the exposure of that employee shall be monitored at least once every 3 months.

(6) If an employee is found to be exposed in excess of the recommended TWA environmental level or ceiling limit, control measures shall be initiated, and the employee shall be notified of the exposure and of the control measures being implemented. The exposure of that employee shall be measured at least once every 30 days. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, indicate that employee exposure no longer exceeds the recommended environmental limits. Quarterly monitoring may then be resumed.

(b) Recordkeeping

Employers or their successors shall maintain records of environmental monitoring for each employee for at least 20 years after the individual's employment has ended. These records shall include: the dates of measurements; job function and location of the employee within the worksite at time of sampling; sampling and analytical methods used and evidence of their accuracy; number, duration, and results of samples taken; TWA determinations based on these samples; type of personal protective equipment in use, if any; name and social security number of the employee being monitored; dates of employment with the company; and information regarding changes in job assignment. Employees and former employees shall have access to information on their own exposures.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon that were prepared to meet the need for preventing occupational diseases arising from exposure to allyl 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."

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 on which standards can be established to protect the health of employees from exposure to hazardous chemical and physical agents. Any criteria and recommended standards should enable management and labor to develop better engineering controls resulting in more healthful work practices and should not be used as final goals.

These criteria for a standard for allyl chloride are part of a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of allyl chloride in products 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 development of toxic effects on the respiratory tract, liver, and kidneys 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.

The major concern in occupational exposure to allyl chloride is its potential for causing liver and kidney damage at low concentrations and lung damage at higher concentrations. Irritation of the eyes and of other sensory organs, dermatitis, and chemical burns have also been associated with exposure to allyl chloride.

Present toxicologic information on allyl chloride is meager. Further epidemiologic research is desirable and experiments are also needed to investigate the possible carcinogenic, teratogenic, and mutagenic properties of allyl chloride. Such experiments should also be used to further elucidate the type and severity of damage associated with chronic exposure conditions. Possible synergistic effects with other chemicals such as epichlorohydrin should be investigated.