

# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ALLYL CHLORIDE

## INTRODUCTION

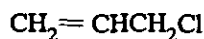
This guideline summarizes pertinent information about allyl chloride for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

## SUBSTANCE IDENTIFICATION

### • Formula



### • Structure



### • Synonyms

3-Chloropropene, 1-chloro-2-propene,  $\alpha$ -chloropropylene, chlorallylene, 3-chloropene, 3-chloro-1-propene, 3-chloropropylene, 2-propenyl chloride

### • Identifiers

1. CAS No.: 107-05-1
2. RTECS No.: UC7350000
3. DOT UN: 1100 57
4. DOT labels: Flammable Liquid, Poison

### • Appearance and odor

Allyl chloride is a colorless, yellow, or purple liquid with an unpleasant, garliclike odor. The odor threshold is reported to be 0.47 part per million (ppm) parts of air.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 76.5
2. Boiling point (at 760 mm Hg): 44° to 45°C (111.2° to 113°F)
3. Specific gravity (water = 1): 0.94
4. Vapor density (air = 1 at boiling point of allyl chloride): 2.6
5. Melting point: -134.5°C (-209°F)
6. Vapor pressure at 20°C (68°F): 295 mm Hg
7. Solubility: Slightly soluble in water; miscible with alcohol, chloroform, ether, and petroleum ether
8. Evaporation rate (butyl acetate = 1): Approximately 7

### • Reactivity

1. Conditions contributing to instability: Violent polymerization and explosions may occur when allyl chloride is heated or comes into contact with acid catalysts, ferric chloride, aluminum chloride, Lewis acids, or Ziegler-type initiators.
2. Incompatibilities: Fires and explosions may result from contact of allyl chloride with ethylene diamine, ethyleneimine, oleum, chlorosulfonic acid, or with benzene or toluene in the presence of ethyl aluminum dichloride or ethyl aluminum sesquichloride.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving allyl chloride.
4. Special precautions: Allyl chloride attacks some coatings and some forms of plastic and rubber. This substance is also highly corrosive to steel.

### • Flammability

The National Fire Protection Association has assigned a flammability rating of 3 (severe fire hazard) to allyl chloride.

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service Centers for Disease Control  
National Institute for Occupational Safety and Health  
Division of Standards Development and Technology Transfer

U.S. DEPARTMENT OF LABOR  
Occupational Safety and Health Administration

1. Flash point:  $-31.7^{\circ}\text{C}$  ( $-25^{\circ}\text{F}$ ) (closed cup)
2. Autoignition temperature:  $391^{\circ}\text{C}$  ( $737^{\circ}\text{F}$ )
3. Flammable limits in air (% by volume): Lower, 3.3; upper, 11.1
4. Extinguishant: Use carbon dioxide, dry chemical, or alcohol foam to extinguish fires involving allyl chloride; do *not* use a solid stream of water because the stream will scatter and spread the fire.

Fires involving allyl chloride should be fought upwind and from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapor explosion and poison hazards may occur indoors, outdoors, or in sewers. Vapors may travel to a source of ignition and flash back. Containers of allyl chloride may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if they hear a rising sound from a venting safety device or if a cylinder becomes discolored as a result of fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half mile in all directions. Firefighters should wear a full set of protective clothing (including a self-contained breathing apparatus) when fighting fires involving allyl chloride. Chemical protective clothing that is specifically recommended for allyl chloride may not provide thermal protection unless so stated by the clothing manufacturer. Firefighters' protective clothing may not provide protection against permeation by allyl chloride.

## EXPOSURE LIMITS

### • OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for allyl chloride is 1 ppm ( $3\text{ mg/m}^3$ ) as an 8-hr time-weighted average (TWA) concentration and 2 ppm ( $6\text{ mg/m}^3$ ) as a short-term exposure limit (STEL). A STEL is a 15-min TWA exposure that should not be exceeded at any time during a workday [29 CFR 1910.1000, Table Z-1-A].

### • NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 1 ppm ( $3\text{ mg/m}^3$ ) as a TWA for an 8-hr workshift and a 40-hr workweek and 2 ppm ( $6\text{ mg/m}^3$ ) as a STEL [NIOSH 1988].

### • ACGIH TLV<sup>®</sup>

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned allyl chloride a threshold limit value (TLV) of 1 ppm ( $3\text{ mg/m}^3$ ) as a TWA for a normal 8-hr workday and a 40-hr workweek and a STEL of 2 ppm ( $6\text{ mg/m}^3$ ) for periods not to exceed 15 min. The TLV also bears a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overexposure [ACGIH 1991b].

### • Rationale for limits

The limits are based on the risk of liver and kidney damage, and neuropathic effects associated with exposure to allyl chloride. The TLV also recommends a "Skin" notation; however, the TLV Committee has solicited quantitative data to serve as a basis for further evaluating the need for a "Skin" notation [ACGIH 1991a].

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Exposure to allyl chloride can occur through inhalation, ingestion, skin absorption, and eye or skin contact.

### • Summary of toxicology

1. *Effects on Animals:* Allyl chloride is an irritant of the eyes, mucous membranes, and skin in animals; chronic exposure causes liver, kidney, lung, and nervous system damage. When instilled into the eyes of rabbits, allyl chloride caused damage rated as 2 on an ascending severity scale of 1 to 10 [Grant 1986]. Prolonged contact of allyl chloride with the skin causes moderate irritation [Clayton and Clayton 1981; NIOSH 1991]. The maximum acute allyl chloride exposures survived by rats were 29,300 ppm for 15 min, 2,900 ppm for 1 hr, and 290 ppm for 3 hr [NLM 1992]. Mice and rats have also survived 6-hr acute exposures of 800 ppm but not 1,000 to 2,000 ppm. The no-effect level in rats was 200 ppm, and dose-related kidney damage was induced in mice and rats exposed to  $\geq 500$  and 300, respectively [ACGIH 1991a]. One of six rats died following an acute 4-hr exposure of 2,000 ppm [Smyth and Carpenter 1948]. The 2-hr  $\text{LC}_{50}$  was 3,514 ppm in rats and 3,674 ppm in mice. The target organs of toxicity were the liver, kidneys, nervous system, and lungs [ACGIH 1991a]. Rats exposed to 16,000 ppm for 2 hr developed eye and nose irritation, weakness, incoordination, drowsiness, and dyspnea before death. Histopathology at autopsy revealed pulmonary hemorrhage, severe kidney damage, and mild liver injury [Proctor et al. 1988]. Tissue burns and pulmonary edema may develop on a delayed basis [NLM 1992]. The dermal  $\text{LD}_{50}$  in rabbits is 2,063 mg/kg [Smyth and Carpenter 1948]. In prolonged contact with the skin, allyl chloride caused moderate irritation [Grant 1986]. The oral  $\text{LD}_{50}$  in rats is

700 mg/kg [Smyth and Carpenter 1948]. Rats, guinea pigs, rabbits, and dogs exposed to allyl chloride at 8 ppm for 7 hr/day for 1 month were asymptomatic but had liver and kidney necrosis at autopsy [Clayton and Clayton 1981]. When these animals were exposed at 3 ppm on the same regimen for 6 months, no exposure-related effects were seen at autopsy (except for reversible liver effects in female rats) [Clayton and Clayton 1981]. Allyl chloride was neurotoxic in multiple species by inhalation, gavage, and parenteral routes of administration. The neurotoxicity has been classified as a degenerative central-peripheral distal axonopathy [ACGIH 1991a]. Allyl chloride was embryotoxic and had developmental effects in rats and mice exposed by inhalation, or by oral or intraperitoneal routes of administration [NIOSH 1991]. Allyl chloride was fetotoxic in rats exposed to 300 ppm, but not in rats exposed to 30 ppm. The chemical was not fetotoxic in rabbits or embryotoxic or teratogenic in rats or rabbits following inhalation of 30 or 300 ppm for 7 hr/day on gestation days 6 to 15 (rats) or 6 to 18 (rabbits) [NLM 1992]. Allyl chloride is mutagenic in *Salmonella typhimurium* and induces gene conversions in *Saccharomyces cerevisiae* [NLM 1992]. It has also been tested for carcinogenicity in mice by several routes of exposure: gavage, skin application, and intraperitoneal injection. A nonsignificant increase in metastasizing squamous cell carcinomas was noted in the forestomachs of mice treated by gavage with doses ranging from 129 to 258 mg/kg. No skin tumors resulted from repeated skin applications; however, allyl chloride acted as an initiator in mice receiving single dermal applications in two-stage carcinogenesis assays. Mice given intraperitoneal injections of allyl chloride showed a significant increase in the incidence of lung adenomas [IARC 1985]. Rats treated by gavage with doses ranging from 55 to 71 mg/kg showed no increase in the incidence of tumors [IARC 1985]. On the basis of these studies, the International Agency for Research on Cancer (IARC) has concluded that there is insufficient evidence that allyl chloride is a carcinogen in treated animals [IARC 1985].

2. *Effects on Humans:* Allyl chloride is an irritant of the eyes, mucous membranes, upper respiratory tract, and skin in humans. Exposure to 25 ppm causes nasal irritation; 50 to 100 ppm causes eye irritation; and concentrations greater than these result in eye pain, conjunctivitis, sensitivity to light, and corneal burns [Grant 1986; Clayton and Clayton 1981; NLM 1992]. Exposure to saturated vapors for a few minutes can be life-threatening [NLM 1992]. Prolonged skin contact may cause a painful sensation described as a deep "bone ache" [Clayton and Clayton 1981]. Other signs and symptoms of chronic exposure have included headache, dizziness, vertigo, nausea, vomiting, proteinuria, hematuria, electrolyte elevations, increased glomerular filtration rates, severe kidney injury, and polyneuropathies [NLM 1992]. Workers exposed to concen-

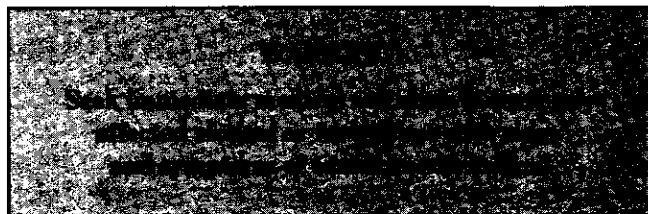
trations of allyl chloride above 3 mg/m<sup>3</sup> (1 ppm) demonstrated evidence of kidney dysfunction; exposures to unspecified concentrations were reported to impart a garlic odor to the breath and skin of exposed workers and to alter the results of their liver function tests [Clayton and Clayton 1981]. Exposed female workers had decreased maximum ventilatory capacities [NLM 1992]. Workers exposed to allyl chloride concentrations ranging from 1 to 113 ppm for 16 months showed clinical signs of reversible liver damage as these signs subsided following cessation of exposure [IARC 1985]. Weakness, paresthesia, numbness, and distal neuropathy have been seen in chronically exposed workers; removal from exposure caused a reversal of their neurotoxic signs and symptoms [ACGIH 1991a].

- **Signs and symptoms of exposure**

1. *Acute exposure:* Exposure to allyl chloride can cause irritation of the eyes, with redness, pain, conjunctivitis, corneal burns, and a sensitivity to light that may not be manifested for several hours after exposure; irritation of the upper respiratory tract, with coughing, difficult breathing, and delayed-onset pulmonary edema; and redness and irritation of the skin.

2. *Chronic exposure:* Exposure to allyl chloride can cause irritation of tissues including the respiratory tract mucosa, photophobia, headache, dizziness, vertigo, nausea, vomiting, dyspnea, deep bone or muscle pain caused by prolonged skin contact, and numbness, weakness, and tingling or prickly sensations in the hands and feet.

- **Emergency procedures**



Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Tissue irritation may result from exposure to concentrated solutions, vapors, mists, or aerosols of allyl chloride. **Immediately and thoroughly** flush eyes with large amounts of water, occasionally lifting the upper and lower eyelids.

2. *Skin exposure:* Skin irritation may result. **Immediately** remove contaminated clothing and **thoroughly** wash contaminated skin with soap and water.

3. *Inhalation exposure*: If vapors, mists, or aerosols of allyl chloride are inhaled, move the victim to fresh air *immediately*.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure*: Take the following steps if allyl chloride or a solution containing it is ingested:

- Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.
- Have the victim drink a glass (8 oz) of fluid such as water.
- Induce vomiting by giving syrup of ipecac as directed on the package. If ipecac is unavailable, have the victim touch the back of the throat with a finger until productive vomiting ceases.
- Do *not* force an unconscious or convulsing person to drink fluid or to vomit.

5. *Rescue*: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

## EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve allyl chloride and may result in worker exposures to this substance:

- Manufacture of glycerin, epichlorohydrin, allyl alcohol, allyl amines, allyl silanes, allyl ethers of starch, and 1,2,3-trichloropropane; pharmaceuticals; polymers, plastics, and resins; perfumes; and insecticides
- Use of allyl chloride as a catalyst and modifier in the production of resins
- Use of allyl chloride in the production of barbiturates and hypnotic agents

The following methods are effective in controlling worker exposures to allyl chloride, depending on the feasibility of implementation:

- Process enclosure
- Local exhaust ventilation
- General dilution ventilation
- Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. Industrial ventilation—a manual of recommended practice. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. Industrial ventilation—a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.
5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

## MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety or health, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

### • Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to allyl chloride, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, liver, kidneys, and respiratory system. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific

job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to allyl chloride at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with chronic eye, respiratory, liver, or kidney abnormalities.

- **Periodic medical examinations and biological monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to allyl chloride exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of allyl chloride on the eyes, liver, kidneys, and respiratory system. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

No biological monitoring test acceptable for routine use has yet been developed for allyl chloride.

- **Medical examinations recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of job placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population. Because occupational exposure to allyl chloride may cause diseases with prolonged latent periods, the need for medical monitoring may extend well beyond the termination of employment.

## **WORKPLACE MONITORING AND MEASUREMENT**

A worker's exposure to airborne allyl chloride is determined by using coconut shell charcoal tubes (100/50-mg sections, 20/40 mesh). Samples are collected at a maximum flow rate of 1.0 liter/min until a maximum air volume of 100 liters is collected. The sample is then treated either with benzene or a mixture of carbon disulfide/dimethylformamide (99:1) to extract the allyl chloride. Analysis is conducted by gas

chromatography using a flame ionization detector. The limit of detection for this procedure is 0.01 mg per sample. This method is described in Method No. 1000 of the *NIOSH Manual of Analytical Methods* [NIOSH 1984].

## **PERSONAL HYGIENE**

If allyl chloride contacts their skin, workers should immediately wash the affected areas with soap and water.

Clothing and shoes contaminated with allyl chloride should be removed immediately, and provisions should be made for safely removing this chemical from these articles. Persons laundering contaminated clothing should be informed about the hazardous properties of allyl chloride, particularly its potential to be irritating to and absorbed by the skin.

A worker who handles allyl chloride should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.

Workers should not eat, drink, or use tobacco products in areas where allyl chloride or a solution containing allyl chloride is handled, processed, or stored.

## **STORAGE**

Allyl chloride should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. The storage area must meet OSHA requirements for Class IB flammable liquids [29 CFR 1910.106]. Containers of allyl chloride should be protected from physical damage and should be separated from incompatible chemicals, heat, sparks, and open flame. To prevent static sparks, metal containers and equipment used to transfer allyl chloride must be grounded and bonded. Because empty containers may still hold allyl chloride residues, they should be handled appropriately.

## **SPILLS AND LEAKS**

In the event of a spill or leak involving allyl chloride, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup is complete. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
2. Notify safety personnel.
3. Remove all sources of heat and ignition.
4. Ventilate potentially explosive atmospheres.
5. Use water spray to reduce vapors, but do not use water spray to prevent ignition in closed spaces.

6. Prohibit contact with the material unless personnel are wearing fully effective personal protective equipment.
7. Absorb small liquid spills with sand or other noncombustible absorbent material and place the material in a covered container for later disposal.
8. Dike far ahead of large liquid spills for later disposal.

## SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether these requirements have been changed.

### • Emergency planning requirements

Allyl chloride is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

### • Reportable quantity requirements for hazardous releases

A hazardous substance release is defined by EPA as any spilling, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of hazardous substances into the environment (including the abandonment or discarding of contaminated containers). In the event of a chemical release that is equal to or greater than the reportable quantity for that chemical, employers are required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the proper Federal authorities.

The reportable quantity for allyl chloride is 1,000 lb. If an amount equal to or greater than this quantity is released within a 24-hr period in a manner that will expose persons outside the facility, employers are required to do the following:

- Notify the National Response Center *immediately* at (800) 424-8802 or at (202) 426-2675 in Washington, D.C. [40 CFR 302.6].
- Notify the emergency response commission of the State likely to be affected by the release [40 CFR 355.40].
- Notify the community emergency coordinator of the local emergency planning committee (or relevant local emergency response personnel) of any area likely to be affected by the release [40 CFR 355.40].

### • Community right-to-know requirements

Employers who own or operate facilities in SIC codes 20 to 39, who employ 10 or more workers, and who manufacture 25,000 lb or more or otherwise use 10,000 lb or more of allyl

chloride per calendar year are required by EPA [40 CFR 372.30] to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of allyl chloride emitted or released from their facility annually.

### • Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Although allyl chloride is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

## RESPIRATORY PROTECTION

### • Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of allyl chloride exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

### • Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic workplace monitoring, and regular

respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

## PERSONAL PROTECTIVE EQUIPMENT

Protective clothing (gloves, face shields, aprons, boots, and body-covering clothing) should be worn to prevent skin contact with allyl chloride. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. Polyvinyl alcohol and Teflon<sup>®</sup> have been tested against permeation by allyl chloride and have demonstrated breakthrough times of 1 to 4 hr. Butyl rubber, natural rubber, polyvinyl chloride, and Viton<sup>®</sup> have demonstrated poor resistance to permeation by allyl chloride.

If allyl chloride is dissolved in water or an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, gas-tight goggles, or face shields should be worn during operations in which allyl chloride might contact the eyes (e.g., through splashes of solution); face shields alone, however, are not adequate for eye protection. Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with allyl chloride. Contact lenses should not be worn if the potential exists for allyl chloride exposure.

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