

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** ALLYL CHLORIDE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ALLYL CHLORIDE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance ALLYL CHLORIDE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions.

(1) "Permissible exposure" means inhalation of allyl chloride in concentrations not in excess of 1 part per million (ppm) (3 milligrams per cubic meter, mg/m³) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for allyl chloride.

(b) Exposure determination and measurement.

(1) Each employer who has a place of employment in which allyl chloride is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of allyl chloride at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of allyl chloride.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to allyl chloride;

(ii) Any measurements of allyl chloride taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to allyl chloride; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to allyl chloride at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to allyl chloride at or above the action level, the employer shall:

(i) Identify all employees who may be exposed at or above the action level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to allyl chloride at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

(6) If an employee exposure measurement reveals that an employee is exposed to allyl chloride above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (D) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to allyl chloride above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to allyl chloride below the action level, the employer may terminate measurement for the employee.

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(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement.

(1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (iv) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
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Above permissible exposure	± 25%
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At or below permissible exposure and above the action level	± 35%
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At or below the action level	± 50%
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(d) Compliance. (1) No employee shall be exposed to allyl chloride above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of allyl chloride shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of allyl chloride.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

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(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of allyl chloride to at or below the permissible exposure; or

(iv) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 - RESPIRATORY PROTECTION FOR ALLYL CHLORIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION

Vapor Concentration	
50 ppm or less	Any supplied-air respirator with a full facepiece, helmet or hood. ----- Any self-contained breathing apparatus with a full facepiece.
300 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet or hood operated in continuous-flow mode.
Greater than 300 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. ----- A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. ----- Any escape self-contained breathing apparatus.

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(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for allyl chloride.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of allyl chloride shall be Class I, Group D.

(3) For the purpose of compliance with § 1910.157, allyl chloride is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of allyl chloride shall be Class I, Group D.

(5) For the purpose of compliance with § 1910.106, liquid allyl chloride is classified as a Class IB flammable liquid.

(6) Where a fan is located in ductwork and where allyl chloride is present in the ductwork in concentrations greater than 8300 ppm (approximately 25% of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(7) Sources of ignition such as smoking or open flames are prohibited where allyl chloride presents a fire or explosion hazard.

(8) Allyl chloride shall be stored so as not to come in contact with strong oxidizers, acids, aluminum, zinc, amines, peroxides, and chlorides of iron and aluminum.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid allyl chloride. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing wet with liquid allyl chloride is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of allyl chloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the allyl chloride, the employer shall inform the person performing the operation of the hazardous properties of allyl chloride.

(3) Where exposure of an employee's body to liquid allyl chloride may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(4) Employers shall ensure that any clothing which becomes wet with allyl chloride or non-impervious clothing which becomes contaminated with liquid allyl chloride be removed immediately and not reworn until the allyl chloride is removed from the clothing.

(5) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply

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with § 1910.133(a)(2)-(a)(6) where liquid allyl chloride may contact the eyes.

(g) Spills and disposal. (1) In the event that liquid allyl chloride is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation and then clean up the spill.

(2) Liquid allyl chloride shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with liquid allyl chloride immediately wash or shower to remove any allyl chloride from the skin.

(2) Employers shall ensure that employees do not eat or smoke in areas where liquid allyl chloride is handled, processed or stored.

(3) Employers shall ensure that employees who handle liquid allyl chloride wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

(i) Training and information. (1) Each employer who has a workplace in which allyl chloride is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to allyl chloride above the action level or employees who may have skin or eye contact with liquid allyl chloride, or employees who work where allyl chloride presents fire or explosion hazard or where an accidental spill of allyl chloride may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for allyl chloride (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to allyl chloride.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to allyl chloride which are listed in Appendix A of the section;

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to allyl chloride.

(j) Medical surveillance. The employer shall medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall make available to each employee who is to be exposed to liquid allyl chloride or airborne concentrations of allyl chloride at or above the action level, without regard to the use of respirators, a medical examination which shall include as a minimum the following:

(i) A medical history and physical examination with emphasis on the lungs, liver, kidneys and eyes.

(ii) 14" x 17" chest roentgenogram.

(iii) Pulmonary function testing, FVC and FEV (1 sec).

(3) The employer shall obtain from the physician, as a record of the examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(ii) 14" x 17" chest roentgenogram or a medically acceptable copy.

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(iii) A record of the results of the pulmonary function testing.

(4) The employer shall make available to each employee, exposed to allyl chloride in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in excess of the action level thereafter, a medical examination which must include the following:

(i) A medical history and physical examination (see paragraph (j)(2)(i) of this section).

(ii) Pulmonary function testing, FVC and FEV (1 sec).

(iii) 14" x 17" chest roentgenogram when indicated by results of pulmonary function testing.

(5) The employer shall obtain from the physician, as a record of the periodic examination, the following information:

(i) A written opinion which conforms with paragraph (j)(7) of this section.

(ii) 14" x 17" chest roentgenogram or a medically acceptable copy.

(iii) A record of the results of the pulmonary function testing.

(6) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with its Appendixes A, B, and C for allyl chloride;

(ii) A description of the employee's duties as they relate to his exposure to allyl chloride;

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurement which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examination of the affected employee.

(7)(i) The physician's written opinion shall be a signed statement by the examining physician specifically stating: (A) Whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from exposure to allyl chloride or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to allyl chloride, including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to allyl chloride.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(8) No employee shall be exposed to liquid allyl chloride or airborne concentrations of allyl chloride in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(9) The employer shall provide emergency and follow up medical examinations and treatment for any employee injured through exposure to allyl chloride.

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(10) If the examining physician chooses to use alternative medical examinations to those specified in paragraphs (j)(2) and (4) of this section, the employer may accept such alternative medical surveillance examinations as meeting the requirements of this part provided that the employer:

(i) Obtains a statement from the examining physician setting forth the alternative medical examinations and the rationale for substitution and evidence that they will be equally effective.

(ii) Informs each exposed employee of the fact that alternative medical examinations to those required in paragraphs (j)(2) or (4) of this section are to be made available.

(11) If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risks involved by refusing to be examined.

(12) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) The record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to allyl chloride.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to allyl chloride which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

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(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) The record shall include:

(A) Results of tests required by paragraph (j)(2) and (j)(5) of this section;

(B) Any employee medical complaints relative to exposure to allyl chloride;

(C) A copy of information provided to the physician pursuant to paragraph (j)(6)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(iii) This record shall be maintained for the duration of the employment of the affected employee.

(6) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(1) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to allyl chloride which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to allyl chloride requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of allyl chloride that are being performed at the place of exposure; and

(iii) Record the results obtained.

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NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR ALLYL CHLORIDE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Allyl chloride
- B. Permissible Exposure: 1 part of allyl chloride per million parts of air (ppm) or 3 milligrams of allyl chloride per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.
- C. Appearance and Odor: Colorless, yellow or purple liquid with an unpleasant pungent odor.

II. HEALTH HAZARD DATA

- A. Ways in Which the Chemical Affects Your Body: Allyl chloride can affect your body if you inhale it or if it comes in contact with your eyes and skin or if you swallow it. It may be absorbed through the skin.
- B. Effects of Overexposure:
 - 1. Short-Term Exposure: Allyl chloride vapors may cause nose, throat, lung and eye irritation (with eye pain) and injury to the liver and kidney. Lung injury may appear several hours after exposure. Liquid allyl chloride may cause a chemical burn and deep-seated eye pain on contact with the eyes. It may also irritate the skin and be absorbed through the skin.
 - 2. Long-Term Exposure: Repeated or prolonged exposure to allyl chloride by inhalation or skin contact may cause injury to the kidneys or liver. Prolonged skin contact may burn the skin and may also produce a delayed deep muscle ache described as "deepbone" ache.
 - 3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to allyl chloride

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If allyl chloride gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If allyl chloride gets on your skin, immediately wash the contaminated skin using soap or mild detergent and water. If allyl chloride soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.
- C. Breathing: If you or any other person breathes in large amounts of allyl chloride, move the exposed person to fresh air at once. If breathing has stopped, perform artificial

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respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- D. Swallowing: When allyl chloride has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.
- E. Rescue: Move affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to allyl chloride. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you can smell allyl chloride while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid allyl chloride. Replace or repair impervious clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) where eye contact to liquid allyl chloride may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Allyl chloride is a flammable liquid and its vapors easily form explosive mixtures with air.
- B. Allyl chloride must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong oxidizers, acids, aluminum, zinc, amines, peroxides, and chlorides of iron and aluminum.
- C. Sources of ignition such as smoking and open flames are prohibited wherever allyl chloride is handled, used or stored in a manner that could create a potential fire or explosion hazard.

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- D. You must use non-sparking tools when opening or closing metal containers of allyl chloride, and containers must be bonded and grounded when pouring or transferring liquid allyl chloride.
- E. If your skin becomes contaminated with liquid allyl chloride, you must immediately wash or shower using soap or mild detergent and water to remove any allyl chloride from the skin.
- F. You must immediately remove any non-impervious clothing that becomes contaminated with liquid allyl chloride and this clothing must not be reworn until the allyl chloride is removed from the clothing.
- G. Clothing wet with allyl chloride can easily be ignited. You must immediately remove this clothing and it must not be reworn until the allyl chloride is removed from the clothing.
- H. You must not eat or smoke in areas where liquid allyl chloride is handled, processed or stored.
- I. If you handle liquid allyl chloride, you must wash your hands thoroughly with soap or mild detergent and water before eating or smoking.
- J. Fire extinguishers and quick drenching facilities, where provided, must be readily available and you should know where they are how to operate them.
- K. Ask your supervisor where allyl chloride is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

- A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for allyl chloride. In addition, your employer must instruct you in the safe use of allyl chloride, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to allyl chloride. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR ALLYL CHLORIDE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 3-chloropropene; 1-chloro-2-propene
2. Formula: $\text{CH}_2=\text{CHCH}_2\text{Cl}$
3. Molecular weight: 76.5

B. Physical Data

1. Boiling point (760 mm Hg): 44.6 C (112 F)
2. Specific gravity (Water = 1): 0.94
3. Vapor density (air = 1 at boiling point of allyl chloride): 2.6
4. Melting point: -134.5 C (-209 F)
5. Vapor pressure at 20 C (68 F): 295 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.36
7. Evaporation rate (butyl acetate = 1): 7 (approximately)
8. Appearance and odor: Colorless, yellow, or purple liquid with an unpleasant, pungent odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: -31.7 C (-25 F) (closed cup)
2. Autoignition temperature: 391 C (737 F)
3. Flammable limits in air, % by volume: Lower: 3.3; Upper: 11.1
4. Extinguishing media: Dry chemical, alcohol foam, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Allyl chloride is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be control where allyl chloride is handled, used or stored in a manner that may create a potential fire or explosion hazard. Allyl chloride vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which allyl chloride is handled. Allyl chloride may polymerize and burst its containers when heated in a fire.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, allyl chloride is classified as a Class IB flammable liquid. For example, above 8300 ppm, one-fourth of the lower flammable limit, is one situation in

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which allyl chloride is considered to be a potential fire and explosion hazard.

8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for allyl chloride shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers, acids, aluminum, zinc, amines, peroxides, and chlorides of iron and aluminum may cause violent polymerizations, fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapor (such as hydrogen chloride, phosgene and carbon monoxide) may be released in a fire involving allyl chloride.
4. Special precautions: Allyl chloride will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If allyl chloride is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Allyl chloride may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

- C. Waste disposal methods: Allyl chloride may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. Exposure above the action level: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84. Portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement

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must determine the concentration of allyl chloride to plus or minus 35%.

- B. Exposure above the permissible exposure: The monitoring and measurements under this section should be essentially the same as described under paragraph (IV)(A). Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of allyl chloride to plus or minus 25%.
- C. Methods: Methods meeting the above accuracy requirements are available from NIOSH.
- D. Qualified Persons: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store allyl chloride in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to allyl chloride can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal allyl chloride containers. These containers must be effectively grounded and bonded prior to pouring.
- D. The use of steel valves on containers and piping for allyl chloride must be avoided because of severe corrosion.
- E. Employers should advise employees of all areas and operations where exposure to allyl chloride could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to allyl chloride is likely to occur are: during its use as a chemical intermediate in the manufacture of glycerin, glycerol, resins, epichlorohydrin, glycidyl ethers, 1,2,3-trichloropropane, allyl ethers of starch, allyl alcohols, allyl amines, allyl silanes, and pharmaceuticals; and during its production.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Allyl chloride vapor is a respiratory irritant, and in animals has caused damage to the liver and kidneys. Rats did not survive when exposed for more than 15 minutes to 29,300 ppm, or longer than 3 hours to 290 ppm; there was alveolar hemorrhage in the lungs, and severe kidney injury. Several species exposed to 8 ppm for 7 hours daily for 1 month showed no apparent ill effects, but histopathologic examination revealed focal necrosis in the liver and necrosis of the convoluted tubules of the kidney; at 3 ppm for 6 months, rats showed slight centri-lobular degeneration in the liver. The most frequent effects in man following overexposure have been conjunctival irritation and eye pain with photophobia; eye irritation occurs between 50 and 100 ppm. Irritation of the nose occurs at levels below 25 ppm. This substance is a skin irritant, and may be absorbed through the skin, causing deepseated pain. If splashed in the eye, severe irritation would be expected. Systemic intoxication of humans has not been reported as is most occupational disease not reported.

III. SIGNS AND SYMPTOMS

Eye, nose and skin irritation; pulmonary edema may occur several hours after exposure. Liver and kidney damage has been reported in animals.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Watch for delayed irritant effects on the eyes, or lungs and for kidney and liver injury. If overexposed, consideration should be given to hospitalization and observation for pulmonary edema. Treat irritated skin as for a thermal burn. Affected eyes should be examined for possible corneal damage; protect eyes from bright light.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of allyl chloride are caused by its irritant properties on the eyes and nose. In animals, repeated exposure at low levels causes lung, kidney, and liver injury. It is important

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that the physician becomes familiar with plant operating conditions in which exposure to allyl chloride occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

The following medical procedures must be made available to each employee who is exposed to allyl chloride:

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of respiratory system, eyes, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.
2. FVC and FEV (1 sec) -- Allyl chloride is a severe pulmonary irritant in animals.
3. 14" x 17" chest roentgenogram -- Allyl chloride may cause lung damage. Surveillance of the lungs is indicated.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis except that an x-ray is required only when indicated by pulmonary function testing.

References

1. American Conference of Governmental Industrial Hygienists: "Allyl Chloride," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 8.
2. Hygienic Guide Series: "Allyl Chloride," American Industrial Hygiene Association Journal, 24:638-640, 1963.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1317-1319.
4. Torckelson, T. R., et al: "Vapor Toxicity of Allyl Chloride as Determined on Laboratory Animals," American Industrial Hygiene Association Journal, 20:217-223, 1959.

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REFERENCES AND SOURCES
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1910.93

- (e) Fire and Safety
- (1) Electrical - Classification based on "Fire Hazard Classification of Chemical Vapors Relative to Explosion-proof Electrical Equipment," H. Carhart et al, National Academy of Sciences, 1973, report to U. S. Coast Guard, report no. CG-D-92-74, p. 8
- (f) Personal Protective Equipment, and, (h) Sanitation
- Eye: "Properties and Essential Information for Safe Handling and Use of Allyl Chloride," Chemical Safety Data Sheet, Manufacturing Chemists Association, Washington, D. C., 1973; Sax, "Dangerous Properties of Industrial Materials;" Patty, "Industrial Hygiene and Toxicology;" Grant, W. Morton, "Toxicology of the Eye," Springfield, Illinois, Charles C. Thomas, 1974
- Skin: "Properties and Essential Information for Safe Handling and Use of Allyl Chloride," Chemical Safety Data Sheet, Manufacturing Chemists Association, Washington, 1973; Sax, "Dangerous Properties of Industrial Materials;" Patty, "Industrial Hygiene and Toxicology;" "Encyclopedia of Occupational Safety and Health," International Labour Office; AIHA Hygienic Guide
- Ingestion: Patty, "Industrial Hygiene and Toxicology;" Deichmann and Gerarde, "Toxicology of Drugs and Chemicals"

COMMENTS

Eye - Classification: 2

Statement numbers: 10

Exceptions: None

MCA reports that allyl chloride is "capable of causing serious eye effects" and can produce "marked irritation and a chemical burn of the cornea." Grant states that "the application of a drop to a rabbit eye caused only mild, transient injury, 2 on a scale of 1 to 10," possibly due to the chemical's low boiling point and rapid evaporation rate. The Dow MSDS reports that an eye burn may occur and notes that "eye effects may be delayed." The AIHA Guide reports that the severity of hazard is moderate for eye contact. Examination of this literature indicates that sources which cite experimental work don't consider the hazards severe; those which don't, do. It is therefore theorized that these latter sources are basing possible eye effects on the skin contact hazards of the substance and not on actual experiments. Such an analysis would lead to the conclusions arrived at if the high vapor pressure and low solubility of the liquid were not taken into account.

Skin - Classification: 2

Statement numbers: 2, 7b, 8b, 14i, 14g and 21 combined.

Exceptions: See below

MCA records that contact with liquid allyl chloride is irritating and will cause a burn if decontamination is not rapid. Prolonged skin contact can result in kidney or liver injury and deep-seated pain. Patty reports a

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rabbit skin penetration LD50 of 2.2 g/kg determined over 24 hours. Sax notes that "acute exposure (through skin absorption) in experimental animals has resulted in irritation of skin and swelling of the kidneys." The AIHA Hygienic Guide notes that "contact with even very small amounts of the liquid will occasion complaints of bone aches or bone pains." The data indicate that all possibility of contact need not be prevented; but when contact occurs, immediate steps should be taken to remove the contaminant. The flash point of the liquid is -31.7 C. Its vapor pressure at 20 C is 295 mm Hg. Consequently, the substance is given a classification of 2 for skin contact to the liquid but statement 8b is specified where exposure of an employees body may occur and statement 14 is used instead of those numbered 16 or 17. Statement 20a is not necessary because of the high vapor pressure of the substance.

Ingestion: Classification: 1

Output statement numbers: 19, 20b

Exceptions: None

Patty gives an oral rat LD50 of 0.7 g/kg of body weight. It is reported in the documentation of the TLV's that inhalation of allyl chloride has caused damage to the liver and kidneys.

Deichmann and Gerarde report "a moderate to high degree of toxicity by ingestion. Small quantities found on contaminated cigarettes, food, and hands could cause injury, particularly from repeated contact." Though the vapor pressure of this substance is 295 mm Hg at 20 C, the data specifically and clearly indicate that ingestion of very small amounts can be hazardous. A classification of 1 is therefore concluded to be warranted.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)

Manufacturing Chemists Association, Chemical Safety Data Sheet SD-99 (1973) (MCA)

Dow Chemical USA, Material Safety Data Sheet (Dow)

Shell Chemical Co., Technical Bulletin IC:69 - 22 and Material Safety Data Sheet (Shell)

Bureau of Mines, "Limits of Flammability of Gases and Vapors," 1952 (BOM)

Sources of data items used:

- I. A. 1. Synonyms: MCA
- 2. Formula: NFPA-49; Dow
- 3. Molecular weight: Shell
- B. 1. Boiling point: MCA; Shell; Dow
- 2. Specific gravity: NFPA-49; MCA; Dow; Shell
- 3. Vapor density: Shell; Dow
- 4. Melting point: MCA; Shell

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5. Vapor pressure: MCA; Dow; Shell
 6. Solubility in water: MCA; Dow
 7. Evaporation rate: Shell
 8. Appearance and odor: NFPA-49; MCA; Shell
- II.
- A.
 1. Flash point: NFPA-325M; MCA
 2. Autoignition temperature: MCA
 3. Flammable limits: NFPA-49; MCA; Dow; BOM
 4. Extinguishing media: NFPA-49; Dow
 5. Special fire fighting procedures: NFPA-49; Dow
 6. Unusual fire and explosion hazards: NFPA-49; MCA
 - B.
 1. Conditions contributing to instability: MCA; ADL
 2. Incompatibilities: Shell; Dow; MCA
 3. Hazardous decomposition products: Dow; Shell
 4. Special precautions: ADL
- III.
- A. Steps if released or spilled: NFPA-49; MCA; Shell; Dow
 - C. Waste disposal method: MCA; Dow
 - V. Miscellaneous precautions: NFPA-49; MCA; Shell

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- "Allyl Chloride," American Conference of Government Industrial Hygienists, Hygienic Guide Series, November - December 1963 (Hygienic Guides)
- "Allyl Chloride," Hazard Process Index Hazard Entry No. 10, Contract HSM-99-73-62, National Institute of Occupational Safety and Health (HPI)
- "Allyl Chloride," Technical Bulletin, C:69 - 22, Shell Industrial Chemicals Division (Shell)
- Faith, W. L., Keyes, D. P. and Clark, R. L., "Industrial Chemicals," John Wiley, Inc., 1965 (Faith)
- International Labour Organization, "Encyclopedia of Occupational Health," Geneva, 1972 (ILO)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 1st edition, 1954 (Chem Tech)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 2nd edition, 1972 (K-O)
- Torkelson, T. R., Wolf, M. A., Oyen, F. and Rowe, V. K., "Vapor Toxicity of Allyl Chloride as Determined on Laboratory Animals," American Industrial Hygiene Association Quarterly, 20:217 - 223, 1959 (Torkelson)

References for Specific Use/Exposure

1. ADL estimate
2. Faith, K-O
3. ILO, K-O
4. K-O
5. HPI, Shell
6. HPI
7. Chem Tech, Shell
8. Chem Tech, Shell
9. Chem Tech

References for Specific Control Methods

Torkelson, Hygienic Guide and K-O were the references used in the Specific Control Methods for numbers 1 - 9.

RESPIRATOR TABLE DOCUMENTATION

PERMISSIBLE EXPOSURE: 1 ppm.

WARNING PROPERTIES: Both the odor threshold and the irritation thresholds

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of allyl chloride are well above the permissible exposure level, as stated in Patty. Allyl chloride, therefore, is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

EYE IRRITATION: Allyl chloride is an eye irritant, according to Patty, at concentrations of 50 to 100 ppm. Since Patty does not specifically state that this is the threshold of eye irritation, only full facepiece respirators are permitted for allyl chloride. Grant reports that only slight eye irritation has been observed in guinea pigs and albino rats exposed to 10 mg/l (3190 ppm) allyl chloride.

LFL: The lower flammable limit of allyl chloride is 33,000 ppm.

IDLH: 300 ppm.

IDLH BASIS: Based upon the statement by Deichmann and Gerarde that an 1-hour exposure to 300 ppm might cause serious damage, an IDLH concentration of 300 ppm allyl chloride is assumed for the purposes of this standard.

SUMMARY OF TOXICOLOGY:

Patty reports that "allyl chloride is very irritating to the eyes and upper respirator tract." In addition, both renal damage and lung irritation can result from acute exposures to allyl chloride. Patty notes an acute inhalation exposure study by Adams in which the "maximum exposure time-concentrations in air for a single exposure survived by rats" were determined to be 290 ppm for 3 hours; 2900 ppm for 1 hour; and 29,300 ppm for 15 minutes. For guinea pigs these maximum exposure time-concentrations were 290 ppm for 8 hours; 2900 ppm for 3 hours; and 29,300 ppm for 1/2 hour.

Patty states that eye irritation results from exposures to concentrations of 50 to 100 ppm, while "nose irritation and pulmonary discomfort" may occur below 25 ppm. Twenty-five ppm is the odor threshold for almost all people.

A 24-hour skin absorption LD50 of 2.2 g/kg for rabbits has been reported in the literature, according to Patty.

Deichmann and Gerarde state that a 1-hour exposure to 3000 ppm might cause death, and a 1-hour exposure to 300 ppm might cause serious damage.

The AIHA Hygienic Guides do not give an IDLH concentration, but state that "animal experiments indicate that a 10-minute exposure to 25,000 ppm would be very hazardous, but might allow survival." According to the Hygienic Guides, animal experiments also suggest that an exposure to 2900 ppm for 1 hour would most likely allow survival, while an exposure to 14,500 ppm for 1 hour would probably cause death.

The NIOSH Toxic Substances List reports a rat LCL0 ("the lowest concentration of a substance, other than an LC50, in air which has been reported to have caused death in animals when they have been exposed") for 4 hours of 2000 ppm. The NIOSH Toxic Substances List also reports an LC100 of 6360 ppm for guinea pigs.

VAPOR PRESSURE AT 20 C: 295 mm.

SATURATED AIR CONCENTRATION: 388,000 ppm.

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid and vapor during manufacture and handling of substance	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
2.	Inhalation of vapor and skin contact with liquid and vapor during manufacture of glycerin (including glycerol resins, glycidyl ethers)	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
3.	Inhalation of vapor and skin contact with liquid and vapor during manufacture of epichlorohydrin	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
4.	Inhalation of vapor and skin contact with liquid and vapor during manufacture of allyl alcohol	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
5.	Inhalation of vapor and skin contact with liquid and vapor during manufacture of allylamines	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
6.	Inhalation of vapor and skin contact with liquid and vapor during manufacture of allyl silanes	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
7.	Inhalation of vapor and skin contact with liquid and vapor during manufacture of pharmaceuticals (including allyl isothiocyanate, allyl-substituted barbiturates, and cyclopropane)	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)
8.	Inhalation of vapor and skin contact with liquid	A,B,D	Local exhaust ventilation; personal protective equip-

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and vapor during manufacture of allyl ethers of starch (used surface coatings, adhesives, and plastics)

ment (gloves, respiratory protective devices, protective clothing)

9. Inhalation of vapor and skin contact with liquid and vapor during manufacture of 1,2,3-trichloropropane

A,B,D

Local exhaust ventilation; personal protective equipment (gloves, respiratory protective devices, protective clothing)

- A -- Inhalation
- B -- Skin contact resulting in localized irritation
- C -- Ingestion
- D -- Skin contact resulting in absorption and subsequent systemic poisoning

----- JES2 JOB STATISTICS -----

1,288 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

