

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND  
SUPPORTING DOCUMENTATION FOR

\*\*\* ALLYL ALCOHOL \*\*\*

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

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 ALCOHOL.

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 - "Permissible Exposure" means inhalation of allyl alcohol in concentrations not in excess of 2 parts per million (ppm) (5 milligrams per cubic meter, mg/cu.m.) averaged over an eight hour work shift, as stated in section 1910.93, Table G-1.
- (2) ACTION LEVEL - "Action Level" means one half (1/2) of the permissible exposure for allyl alcohol.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which allyl alcohol is present shall:

- (1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices A, B and C, at the workplace. This material shall be made readily available to affected employees; and
- (2) PRESENCE OF ALLYL ALCOHOL - Inform affected employees of the quantity, location, and manner of use or storage of allyl alcohol.

(c) EXPOSURE MEASUREMENT

- (1) INITIAL DETERMINATION - Each employer who has a place of employment in which allyl alcohol is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of allyl alcohol 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 alcohol. A written determination shall be made and it shall contain at least the following information:

- (i) Any information, observations, or calculations which would indicate employee exposure to allyl alcohol;
- (ii) Any measurements of airborne concentrations of allyl alcohol taken;
- (iii) Any employee complaints of symptoms which may be attributable to exposure to allyl alcohol; and
- (iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

- (2) INITIAL EXPOSURE MEASUREMENT - If the employer determines that any employee may be exposed to airborne concentrations of allyl alcohol at or above the action level, the exposure of the employee believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum exposure of the employee.

- (3) IDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of allyl alcohol 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.

- (4) EXPOSURE ABOVE THE ACTION LEVEL - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of allyl alcohol 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.

- (5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne

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concentrations of allyl alcohol above the permissible exposure, the employer shall:

- (i) Inform the employee of the exposure as required by paragraph (N)(1) of this section; and
- (ii) Measure the exposure of the employee at least monthly; and
- (iii) Institute control measures as required by paragraph (E) of this section.

(6) **TERMINATION OF EXPOSURE MEASUREMENT** - If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to airborne concentrations of allyl alcohol below the action level, the employer may terminate measurement for the employee. For purposes of this subparagraph, use of respirators shall not constitute reduction of employee exposure below the action level.

(d) **METHODS OF MEASUREMENT** - 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 (Appendix B (iv)). The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1 below.

Table 1

Concentration	Required Accuracy
Above permissible exposure	Plus or Minus 25%
At or below permissible exposure and above the action level	Plus or Minus 35%
At or below the action level	Plus or Minus 50%

(e) **Methods of Compliance**

(1) **Engineering controls** - No employee shall be exposed to allyl alcohol above the permissible limit as defined in paragraph (a)(1) of this section. Engineering and work practice controls shall be used to reduce exposure to allyl alcohol to at or below the permissible exposure.

(i) When mechanical ventilation is used to control exposure, measurements which demonstrate system efficiency (for example: air velocity, static pressure, or air volume) shall be made at least every three months. Measurements of system efficiency shall also be made within five work days of any change in production, process or control which might result in a reduction in control.

(ii) In the design of open surface tank ventilation for the purposes of compliance with section 1910.94(d), operations involving allyl alcohol shall be classified as A-2 at 70 F.

(iii) Where a fan is located in duct work and where allyl alcohol is present in concentrations greater than 6250 ppm, one fourth of the lower flammable limit, the fan rotating element shall be of non-sparking material or the casing shall consist of, or be lined with, non-sparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(2) **Respirators**

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

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- (a) During the time period necessary to install engineering controls; or
- (b) In work situations in which engineering controls are technically not feasible; or
- (c) In work situations in which feasible engineering and work practice controls are insufficient to reduce employees exposure to at or below the permissible exposure. Where technically feasible engineering and work practice controls are not sufficient to reduce exposure to at or below permissible exposure, they shall be used to reduce exposure to the lowest level feasible; or
- (d) For operations not exceeding 40 hours per year; or
- (e) In emergencies.
- (ii) Respirators shall be jointly approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.
- (iii) Employers shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.
- (iv) Employers shall institute a respiratory protection program in accordance with sections 1910.134(b),(d),(e) and (f).

TABLE 2. RESPIRATORY PROTECTION FOR ALLYL ALCOHOL

Condition

Vapor Concentration

Equal to or Less  
than 100 ppm

and organic vapor cartridge(s).  
A gas mask with a chin-style or front- or back-mounted organic vapor canister.  
Any supplied-air respirator with a full facepiece, helmet or hood.  
Any self-contained breathing apparatus with a full facepiece.

Equal to or Less  
than 250 ppm

operated in pressure-demand (positive pressure) mode or with a full facepiece, hood, or helmet operated in continuous flow mode.

Greater than  
250 ppm, or  
Entry & Escape  
from Unknown

Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.  
air respirator with a full facepiece operated in pressure-

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Concentrations

auxiliary self-contained air supply operated in pressure-demand mode. Supplied air suits may be necessary.

Fire Fighting

Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.

Escape

Any gas mask providing protection against organic vapors.  
Any escape self-contained breathing apparatus.

(f) Fire and Safety

Employers shall familiarize themselves with the information contained in the Substance Technical Guidelines for allyl alcohol which is contained in Appendix B in order to ensure the safe handling and use of allyl alcohol.

- (1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of allyl alcohol shall be Class I Group C.
- (2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, allyl alcohol is classified as a Class B fire hazard.
- (3) Powered industrial trucks - For the purposes of compliance with section 1910.178, locations classified as hazardous locations due to the presence of allyl alcohol shall be Class I Group C.
- (4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid allyl alcohol is classified as a Class IB flammable liquid. Spray finishing operations shall be performed in accordance with sections 1910.107 and 1910.94(c). Dip tank operations shall be performed in accordance with sections 1910.108 and 1910.94(d).
- (5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where allyl alcohol is handled, used or stored in a manner so as to create a potential fire or explosion hazard.
- (6) Storage - Allyl alcohol shall be stored so as not to come in contact with strong oxidizers.

(g) Personal Protective Equipment

(1) Skin Contact

- (i) Employers shall provide, and require employees to use, impervious clothing, gloves, face shields (8 inch minimum) and other appropriate protective clothing necessary to prevent any possibility of skin contact to liquid allyl alcohol. Face shields shall comply with section 1910.133(a)(6).
- (ii) Employers shall provide, and require employees to use, impervious clothing, gloves and other impervious coverings necessary to prevent repeated or prolonged skin contact to allyl alcohol vapor at or above a concentration of 25 ppm.
- (iii) Employers shall ensure that clothing which has had any possibility of being contaminated with liquid allyl alcohol is placed in closed containers for storage until it can be

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discarded or until the employer provides for the removal of allyl alcohol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the allyl alcohol, the employer shall inform the person performing the operation of the hazardous properties of allyl alcohol.

- (iv) Where there is any possibility of exposure of an employee's body to liquid allyl alcohol, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.
  - (v) Employers shall ensure that clothing which becomes wet with liquid allyl alcohol be removed immediately and not reworn until the allyl alcohol is removed from the clothing.
- (2) Eye Contact
- (i) Employers shall provide, and require employees to use, splash-proof safety goggles (cup-cover type dust and splash safety goggles), which comply with section 1910.133(a)(6), where there is any possibility of liquid allyl alcohol contacting the eye.
  - (ii) Where there is any possibility that an employee's eyes may be exposed to liquid allyl alcohol, employers shall provide an eye wash fountain within the immediate work area area for emergency use.
- (h) Spills
- (1) Spills of allyl alcohol shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.
  - (2) Liquid allyl alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
- (i) Sanitation
- (1) Employers shall ensure that employees whose skin becomes contaminated with liquid allyl alcohol immediately wash or shower to remove any allyl alcohol from the skin.
  - (2) Employers shall ensure that all employees subject to skin contact with liquid allyl alcohol wash any areas of the body which may have contacted allyl alcohol at the end of each day.
  - (3) Employers shall ensure that employees do not eat or smoke in areas where allyl alcohol is handled, processed or stored.
  - (4) Employers shall ensure that employees who handle allyl alcohol wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.
- (j) Training and Information - Each employer who has employees exposed to allyl alcohol in excess of the action level, or employees who may have skin or eye contact with liquid allyl alcohol, or employees who work where accidental release, spill, fire, or explosion of allyl alcohol may occur, shall annually:
- (1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for allyl alcohol, which is contained in Appendix A; and
  - (2) Medical -
    - (I) Advise employees as to the signs and symptoms of exposure to allyl alcohol.

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- (II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to allyl alcohol which are listed in Appendix A.
- (III) Instruct the employees to inform the employer if they develop any of the medical conditions listed in (k)(2) of this section; and
- (3) Procedures -
  - (I) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to allyl alcohol.
  - (II) The procedures required by (j)(1), (2), and (3)(I) shall be provided to employees at the expense of the employer during the employee's normal working hours.

(k) Medical Surveillance

- (1) The employer shall provide medical procedures as required by paragraph (k). These procedures shall be provided at no cost to the employee.
- (2) Preplacement Questionnaire - The employer shall obtain from each employee who will be exposed to liquid allyl alcohol, or airborne concentrations of allyl alcohol at or above the action level, a written statement as to whether such employee has a history of any of the following:
  - (I) Chronic lung disease
  - (II) Skin disease
  - (III) Liver disease
  - (IV) Kidney disease
  - (V) Eye disease
- (3) Preplacement Medical Examination - The employer shall provide a medical examination for an employee if the employee provides a history of any of the conditions named in paragraph (k)(2).
- (4) Results of Preplacement Examination - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(3).
- (5) Periodic Medical Examinations - The employer shall provide a medical examination for an employee if the employee advises the employer of the development of:
  - (I) Any of the medical conditions listed in (k)(2)
  - (II) Signs and symptoms listed in Appendix A which the employee suspects may be caused by exposure to allyl alcohol.
- (6) Results of Periodic Examinations - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(5).

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- (7) Exclusion or Removal from Exposure - No employee shall continue to be exposed to allyl alcohol if such exposure could place the employee at increased risk of material impairment of his health.
- (8) Emergency Procedures - The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to allyl alcohol.
- (9) Informing the Physician - The employer shall provide to the examining physician the following information:
  - (I) A copy of this section with its Appendices A, B and C for allyl alcohol;
  - (II) A description of the employee's duties as they relate to his exposure to allyl alcohol;
  - (III) A description of any personal protective equipment, including respirators, required to be used;
  - (IV) The results of any employee's exposure measurement, if available;
  - (V) The employee's anticipated exposure level; and
  - (VI) Upon request of the physician, information from previous medical examination of the employee.
- (10) Physician's Written Opinion
  - (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 could be directly or indirectly aggravated by exposure to allyl alcohol or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.
    - (B) Any recommended limitations upon the employee's exposure to allyl alcohol.
    - (C) The employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.
  - (II) The written opinion shall not reveal medical information unrelated to exposure to allyl alcohol.
- (11) Refusal to be Medically Examined - 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

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performed within the past six months are acceptable to the examining physician.

(1) Recordkeeping.

(1) Initial determination.

- (i) The employer shall keep an accurate record of all initial determinations required to be made pursuant to paragraph (c)(1) of this section.
- (ii) The record shall include the written determination and any supporting documentation as required in paragraph (c)(1) 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 alcohol.
- (ii) This record shall include:
  - (a) The date of measurement;
  - (b) A reference to the subparagraph of this regulation which required the measurement, if any;
  - (c) Operations involving exposure to allyl alcohol which are being monitored;
  - (d) Sampling and analytical methods used and evidence of their accuracy;
  - (e) Number, duration, and results of samples taken;
  - (f) 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 a record of measurements demonstrating the effectiveness of such ventilation as required by paragraph (e)(1)(i) of this section.
- (ii) This record shall include:
  - (a) Date of measurement;
  - (b) Type of measurement taken;
  - (c) Result of measurement.
- (iii) This record shall be maintained for at least one year.

(4) Training and information.

- (i) The employer shall keep an accurate record of all employee training and advice required by paragraph (j) of this section.
- (ii) The record shall include:
  - (a) Date of training;
  - (b) Name and Social Security number of employees trained;
  - (c) Substance of training provided.
- (iii) This record shall be maintained until replaced by a more recent record.

(5) Medical records.

- (i) The employer shall keep an accurate medical record for each employee.
- (ii) The record shall include:

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- (a) Physician's written opinion;
  - (b) Preplacement questionnaire;
  - (c) Any employee medical complaints relative to exposure to all
  - (d) A signed statement of any refusal to be examined;
  - (e) A copy of information provided to the physician pursuant to paragraph (k)(9)(ii) through (vi) of this section.
- (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 and the Director.
  - (ii) Employee 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.
- (m) Observation of monitoring.
- (1) Duty.
- The employer shall give affected employees or their representatives an opportunity to observe any monitoring of employee exposure to allyl alcohol which is conducted pursuant to this section.
- (2) Exercise of opportunity to observe monitoring.
- (i) When observation of the monitoring of employee exposure to allyl alcohol requires entry into an area where the use of personal protective devices is required, the observer shall use such equipment and comply with all other applicable safety procedures.
  - (ii) Without interfering with the measurement, observers shall be entitled to:
    - (a) Receive an explanation of the measurement procedures;
    - (b) Visually observe all steps related to the measurement of exposure to allyl alcohol that are being performed at the place of exposure.
    - (c) Record the results obtained.
- (n) Employee notification.
- (1) The employer shall notify in writing, within five work days, every employee who is found to be exposed to allyl alcohol above the permissible exposure. The employee shall also be notified of the level of his exposure and the corrective action being taken to reduce the exposure to at or below the permissible exposure.
- (2) Pursuant to paragraph (k) of this Section, when an employee is medically examined the employer shall provide the employee with a copy of the physician's written opinion.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Allyl alcohol

PERMISSIBLE EXPOSURE: 2 parts of allyl alcohol vapor per million parts of air (ppm) or 5 milligrams of allyl alcohol vapor per cubic meter of air (mg/cu m).

APPEARANCE AND ODOR: Colorless liquid with a mustard-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Allyl alcohol can affect your body if it is swallowed, inhaled, or if it comes in contact with your skin or eyes.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to allyl alcohol may cause irritation of the eyes, nose and skin. Absorption through the skin or eyes may cause deep-seated pain in the region where the absorption occurred. Severe eye burns may occur from eye contact with this chemical. Burns of the skin may also occur. Exposure to high air concentrations of allyl alcohol may cause irritation of the lungs, nausea and vomiting.

2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with allyl alcohol exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If allyl alcohol gets into your eyes, wash the eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If allyl alcohol gets on your skin, flush the contaminated skin with water immediately. If allyl alcohol soaks through your clothing, remove the clothing immediately and flush the skin with water. Do not rewear the clothing until the allyl alcohol has been removed. Replace or repair impervious clothing that has developed leaks. If there is skin irritation get medical attention promptly.

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- C. Breathing: If you or any other person breathes in large amounts of allyl alcohol remove the exposed person to fresh air at once. When breathing is difficult, properly trained personnel may assist the affected person by administering oxygen. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.
- D. Swallowing: When allyl alcohol has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger after giving him large amounts of water 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 alcohol. You can only be required to wear them for routine use if your employer is in the process of installing controls or other 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)/National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) If you can smell allyl alcohol 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 shields and other appropriate protective clothing to prevent any possibility of skin contact with liquid allyl alcohol and to prevent repeated or prolonged contact with allyl alcohol vapor at or above a concentration of 25 ppm.
- C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) if there is any possibility of liquid allyl alcohol contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Allyl alcohol is a flammable liquid and its vapors easily form explosive mixtures with air. It must be stored in tightly closed containers in a cool, well-ventilated areas away from heat, sparks, flames and strong oxidizers. Sources of ignition such as smoking and open flames are prohibited wherever allyl alcohol is handled, used or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of allyl alcohol, and containers must be bonded and grounded when pouring or transferring liquid allyl alcohol. If your skin becomes contaminated

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with liquid allyl alcohol, you must immediately wash or shower to remove any allyl alcohol from the skin. The effects of skin contact with allyl alcohol may be delayed, so you must wash whether or not you feel an immediate effect. You must immediately remove any clothing that becomes wet with liquid allyl alcohol and this clothing must not be reworn until the allyl alcohol is removed from the clothing. If your skin is subject to contact with liquid allyl alcohol, you must wash any areas of your body that may have contacted liquid allyl alcohol at the end of each work day. You must not eat or smoke in areas where allyl alcohol is handled, processed or stored. If you handle allyl alcohol, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities. Fire extinguishers, eye flushing facilities and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where allyl alcohol is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES  
ALLYL ALCOHOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2-propenol; 2-propen-1-ol; vinyl carbinol
2. Formula:  $\text{CH}_2=\text{CHCH}_2\text{OH}$
3. Molecular weight: 58

B. Physical Data

1. Boiling point (760 mm Hg): 97 C (206 F)
2. Specific gravity (water=1): 0.9
3. Vapor density (air=1 at boiling point of allyl alcohol): 2.0
4. Melting point: -129 C (-200 F)
5. Vapor pressure at 20 C (68 F): 17.2 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): data not available
8. Appearance and odor: Colorless liquid with an odor like mustard.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 21 C (70 F) (closed cup)
2. Autoignition temperature: 378.4 C (713 F)
3. Flammable limits in air, % by volume: Lower: 2.5; Upper: 18.0
4. Extinguishing media: Alcohol foam, dry chemical, 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 alcohol is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where allyl alcohol is handled, used or stored. Allyl alcohol 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 alcohol is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, allyl alcohol is classified as a Class IB flammable liquid. At 6250 ppm, one-fourth of the lower flammable limit, allyl alcohol is considered to be a potential fire and explosion hazard.

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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 alcohol shall be Class I Group C.

B. Reactivity

1. Conditions contributing to instability: heat
2. Incompatibilities: Contact with strong oxidizers may cause fire and explosion
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving allyl alcohol.
4. Special precautions: Allyl alcohol will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If allyl alcohol 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) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Allyl alcohol 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 alcohol may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary landfill.
2. By atomizing in a suitable combustion chamber.

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 sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. 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, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of allyl alcohol to plus or minus 35%.
- b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph

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IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of allyl alcohol to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. Store allyl alcohol in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to allyl alcohol can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal allyl alcohol containers. These containers must be effectively grounded and bonded prior to pouring.
- D. The employer should provide showers in those areas where skin contamination may occur to the extent that showers would be necessary for adequate cleansing of the body.
- E. Use of air-supplied suits may be necessary for entry into locations where the airborne concentration of allyl alcohol is greater than 250 ppm. These suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of air-supplied suits.
- F. Employers must advise employees of all plant areas and operations where exposure to allyl alcohol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to allyl alcohol is likely to occur are: its use in the synthesis of allyl ethers, esters, and co-polymers; its use in perfumes, flavorings and pharmaceuticals; in its use as a fungicide, herbicide, and nematocide; and in its use in refining and dewaxing of mineral oil.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

The vapor of allyl alcohol is highly irritating to the eyes and nose of human subjects. At 25 ppm lacrimation, retrobulbar pain, photophobia, and blurring of vision have been reported. The lethal concentration for rats of 150 ppm produces pathologic changes in the lungs and liver. Skin absorption produces injury to the liver and kidneys in animals. In man, skin contact causes burns, and absorption through the skin results in pain in the underlying tissue and gastro-intestinal symptoms. Contamination of the eye with the liquid produces corneal damage. No cases of systemic intoxication in humans have been reported, although there is a risk of delayed pulmonary edema following the inhalation of high concentrations of the vapor.

III. SIGNS AND SYMPTOMS

Severe irritation and possible tissue damage of the eyes, upper respiratory tract, and skin from exposure to the vapor and liquid. At high levels of exposure, symptoms of pulmonary edema may occur.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Oxygen therapy, bed rest and symptomatic treatment are indicated if pulmonary edema develops. Treat irritated skin as for a thermal burn. Pain may be alleviated by 10 ml of 10% calcium gluconate intravenously. Affected eyes should be examined for possible loss of corneal substance and appropriate treatment instituted. Protect eyes from bright light. An ophthalmic local anesthetic will give relief from pain. If swallowed and the person is conscious, induce vomiting.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of allyl alcohol are caused by its severe irritant properties. It may be a lung irritant at high doses and exposed persons should be observed for delayed pulmonary edema. It is important that the physician becomes familiar with plant operating conditions in which exposure to allyl alcohol occurs. Those with skin disease may not tolerate the wearing of protective

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clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

Routine medical histories and physical examination are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the inhalation of allyl alcohol might cause exacerbation of symptoms due to its irritant properties.
2. Skin disease -- Allyl alcohol can cause skin burns. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.
3. Liver disease -- Although allyl alcohol is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.
4. Kidney disease -- Although allyl alcohol is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.
5. Eye disease -- Because allyl alcohol is reported to cause eye injury, those with pre-existing eye diseases may be at increased risk.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above-listed conditions, he must refer such employee for further medical examination.

References

1. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 377-381.
2. American Conference of Governmental Industrial Hygienists: "Allyl Alcohol," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 7.

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3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1483-1488.

4. Hygienic Guide Series: "Allyl Alcohol," Industrial Hygiene Journal, 24:636-638, 1963.

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REFERENCES AND SOURCES

ALLYL ALCOHOL

1910.93

(f) Personal Protective Equipment, and (h) Sanitation

Eye: Grant, "Toxicology of the Eye"

Browning, "Toxicity and Metabolism of Industrial Solvents"

Patty, "Industrial Hygiene and Toxicology"

Skin: Grant, "Toxicology of the Eye"

Browning, "Toxicity and Metabolism of Industrial Solvents"

Patty, "Industrial Hygiene and Toxicology"

Documentation of Threshold Limit Values

Gleason, "Chemical Toxicology of Commercial Products"

Ingestion: Browning, "Toxicity and Metabolism of Industrial Solvents"

Patty, "Industrial Hygiene and Toxicology"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

Grant reports "the liquid tested on rabbit eyes by application of a drop caused moderately severe reaction consisting of conjunctival edema and hyperemia with transient clouding of the cornea, graded 5 on a scale of 10 at 24 hours. The corneal opacities disappeared within 48 hours, and the eyes were completely normal within a week. Accidental splashes of liquid in human eyes similarly have produced moderately severe reactions, usually with prompt healing, but in one exceptional case healing took several days." The grade of 5 indicates that 0.005 ml of the undiluted chemical causes less than severe injury in the eye after 24 hours while 0.02 ml does produce severe injury - as "severe injury" is defined by Smyth and Carpenter. Browning, also referring to the work of Smyth and Carpenter, reports "application to the eyes causes erythema of the conjunctiva and swelling of the cornea, sometimes with opacity, but no permanent injury." Patty agrees with the above.

A classification of 2 is concluded to be appropriate since any injury caused is reversible.

Skin - Classification: 1 and 4

Output statement numbers: 1, 4, 7a, 8a, 21 and 14g combined,  
14i, 20a

Exceptions: None

Grant reports that "on the skin the liquid has a delayed effect, causing aching which begins several hours after contact, followed by blistering." Browning states that "application to the skin causes only slight erythema lasting about 48 hours" for local effects but also notes cases of "muscular spasm (deep 'bone ache') resulting from absorption through the skin. Contact with the skin for 20 min, has been stated by Oettel to cause pain, erythema, and hyperemia." She reports that Smyth and Carpenter found a rabbit skin penetration LD50 for the substance of 0.053 ml/kg. Patty gives a rabbit skin LD50 of 89 ml/kg and adds that the skin

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irritation effects to guinea pigs are "slight erythema in 1 of 12." The Documentation of TLV's clarifies discrepancies in the literature regarding local effects and summarizes the systemic effects of skin contact by reporting "skin penetration may lead to serious systemic injury (visceral congestion, periportal congestion of the liver, hematuria, and nephritis) and skin contact causes burns when evaporation is prevented or reduced." Gleason concludes the "liquid may produce first or second degree burns with blistering and superficial necrosis. Penetration through intact skin is dangerous."

The vapor pressure of allyl alcohol at 20 degrees C is 17.2 mm Hg. It is miscible in all proportions with water and has a flash point of 70 degrees F.

The data indicate that this substance is extremely readily absorbed through the skin with possible severe consequences. It is therefore assigned classifications of 1 and 4. To guard against repeated or prolonged skin contact with the vapor, statement 4 is utilized. The concentration of 25 ppm inserted was chosen based on information given in the Medical Surveillance Guidelines.

Ingestion: Classification: 1

Output statement numbers: 19,20a

Exceptions: None

Browning reports an acute LD50 for rats of 0.064 g/kg and notes "72 mg/kg/day (in drinking water) caused very few signs of abnormality. Loss of weight, transient pulmonary rales and crustiness of the eyelids were not accompanied by other signs of illness, and the only organic abnormalities observed were local areas of necrosis in the liver." Patty reports that "repeated ingestion of 42 mg/kg/day by rats resulted in a decrease in the peritoneal fat and well-localized areas of necrosis with regeneration in the liver. Nothing remarkable was observed at lower levels." In a table, Patty reports "dosage of 9.7 mg/kg given daily in the diet over the period of 30 days resulted in reduced appetite, mortality, and microscopic lesions of the tissues."

Browning also notes that there is no accumulation in the body and that the substance is completely metabolized. Patty adds that it is oxidized readily and that within an hour after intravenous injection to rats with the dosage of 30 mg/kg, "the alcohol had almost disappeared from the blood. During constant intravenous infusion the allyl alcohol disappeared at a rate of 23 mg/hr."

The probable lethal dose for this substance would be about 1 teaspoonful for humans. Since chronic ingestion of much smaller amounts may also cause significant effects, the substance is assigned a classification of 1.

SUBSTANCE TECHNICAL GUIDELINES

ALLYL ALCOHOL

I. PHYSICAL AND CHEMICAL DATA

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A. Substance Identification

1. Synonyms: 2-propenol; 2-propen-1-ol; vinyl carbinol
2. Formula:  $\text{CH}_2\text{:CHCH}_2\text{OH}$
3. Molecular weight: 58

B. Physical Data

1. Boiling point (760 mm Hg): 97 C (206 F)
2. Specific gravity (water=1): 0.9
3. Vapor density (air=1 at boiling point of allyl alcohol): 2.0
4. Melting point: -129 C (-200 F)
5. Vapor pressure at 20 C (68 F): 17.2 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): data not available
8. Appearance and odor: Colorless liquid with an odor like mustard.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 21 C (70 F) (closed cup)
2. Autoignition temperature: 378.4 C (713 F)
3. Flammable limits in air, % by volume: Lower: 2.5; Upper: 18.0
4. Extinguishing media: Alcohol foam, dry chemical, 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 alcohol is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where allyl alcohol is handled, used or stored in a manner that could create a potential fire or explosion hazard. Allyl alcohol 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 alcohol is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, allyl alcohol is classified as a Class IB flammable liquid. For example, 6300 ppm, approximately one-fourth of the lower flammable limit, is one situation in which allyl alcohol 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 alcohol shall be Class I Group C.

B. Reactivity

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact with strong oxidizers may cause fire and explosion.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving allyl alcohol.

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4. Special precautions: Allyl alcohol will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If allyl alcohol 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. Allyl alcohol 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 alcohol may be disposed of by atomizing in a suitable combustion chamber.

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 sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. 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, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of allyl alcohol to plus or minus 35%.
- b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring 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 (AIHA). The method of measurement must determine the concentration of allyl alcohol to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. Store allyl alcohol in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to allyl alcohol can occur when transferring the liquid from one container to another.

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- C. Non-sparking tools must be used to open and close metal allyl alcohol containers. These containers must be effectively grounded and bonded prior to pouring.
- D. The employer should provide showers in those areas where skin contamination may occur to the extent that showers would be necessary for adequate cleansing of the body.
- E. Use of air-supplied suits may be necessary for entry into locations where the airborne concentration of allyl alcohol is greater than 250 ppm. These suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of air-supplied suits.
- F. Employers should advise employees of all plant areas and operations where exposure to allyl alcohol could occur.

#### VI. COMMON OPERATIONS

Common operations in which exposure to allyl alcohol is likely to occur are: its use in the synthesis of allyl ethers, esters, and co-polymers; its use in perfumes, flavorings and pharmaceuticals; in its use as a fungicide, herbicide, and nematocide; and in its use in refining and dewaxing of mineral oil.

#### RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Allyl alcohol

D. O. L. STANDARD: 2 ppm

#### WARNING PROPERTIES:

Odor Threshold: Patty reports that the odor threshold of allyl alcohol is less than 0.75 ppm. In addition, Patty reports that 5 out of 10 "human volunteers reported a definite odor . . . when exposed to 2 ppm of allyl alcohol for 1 to 3 minutes."

Eye Irritation Level: Patty reports that slight eye irritation occurs at 6.25 ppm allyl alcohol, and moderate eye irritation occurs at 25 ppm.

Other Information: According to Patty, the threshold of nasal irritation is below 0.78 ppm. Moderate nasal irritation occurs at 12.5 ppm. The threshold of pulmonary discomfort is greater than 25 ppm.

Evaluation of Warning Properties: Since allyl alcohol can be detected at a concentration below the permissible exposure limit through its odor and irritant (nasal) effects, this substance is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 150 ppm

Basis for IDLH Value: This IDLH is based upon the report in the AINA Hygienic Guides that "from animal experiments, a single one-hour exposure to 150 ppm might be fatal, while the same exposure to 100 ppm would probably allow survival."

Other Toxicological Information: Patty states that "unlike the vapors of the saturated lower aliphatic alcohols, the vapor of allyl alcohol does not possess particular narcotic properties but rather is an irritant to the mucous membranes and to the lungs."

Patty also reports that "sufficiently high concentration of the vapor of allyl alcohol causes lachrimation, pulmonary irritation, diarrhea, and coma among rats. In the repeated exposure of rats to the vapor, Dunlap et al. reported that retardation of growth appeared at

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20 ppm an increased in the weight of the lungs at 40 ppm, and an increase in the weight of the kidneys at 60 ppm. The vapor of allyl alcohol was toxic to rats when exposed on one occasion, but on repeated exposure the effects seemed to be those of repeated insult rather than those of accumulation in the tissue. For example, one exposure of 8 hours to the concentration of 76 ppm resulted in the death of one of the group of rats (LD50) but the repeated exposure (7 hr/day) to the concentration of 60 ppm resulted in only a LC10."

According to Patty, "Kodoma and Hinc state that the primary cause of death from allyl alcohol is probably cardiovascular failure, which probably follows depression of the respiratory and vasomotor centers and a decrease in effective blood pressure."

The following section of a table is given in Patty:

RESPONSE OF ANIMALS TO INHALATION OF ALLYL ALCOHOL

Concentration (ppm)	Animal	Duration of exposure (hr)	Outcome
1000	Monkey	4	Death
1000	Rabbit	4	LC100
1000	Rat	4	LC100
1000	Rat	1	LC50
1000	Rat	1	LC07
500	Rat	1	Survived
250	Rat	4	Some deaths
165	Rat	4	LC50
76	Rat	8	LC50

Browning reports that "by inhalation, for rats, 1000 ppm caused death to 4 out of 6 animals in 1 hour . . . while 250 ppm killed 2, 3 or 4 out of 6 in 4 hours . . ."

Browning also reports that a lethal dose of allyl alcohol for the rabbit by penetration through the skin is 0.053 ml/kg.

LFL: 25,000 ppm

VAPOR PRESSURE AT 20 C: 17.2 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 22,600 ppm

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USE/EXPOSURE AND CONTROL DOCUMENT

ALLYL ALCOHOL  
Principal Route  
of Entry

Currently Used  
Control Methods

- | Use/Exposure  | Principal Route of Entry | Currently Used Control Methods   |
|---|--------------------------|--|
| 1. Inhalation of vapor and skin and eye contact with vapor and/or liquid during the preparation of various allyl esters which serve as monomers and prepolymers                     | A,B,D                    | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, respiratory protective devices, impervious gloves and clothing |
| 2. Inhalation of vapor and skin and eye contact with vapor and/or liquid during its use in the preparation of chemical derivatives used in perfumes flavorings, and pharmaceuticals | A,B,D                    | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, respiratory protective devices, impervious gloves and clothing |
| 3. Inhalation of vapor and skin and eye contact with vapor and/or liquid during the synthesis of allyl alcohol  | A,B,D                    | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, respiratory protective devices, impervious gloves and clothing |
| 4. Inhalation of vapor and skin and eye contact with vapor and/or liquid during its use as a fungicide, herbicide, and nematocide   | A,B,D                    | Personal protective equipment (goggles, respiratory protective devices, impervious gloves and clothing   |
| 5. Inhalation of vapor and skin and eye contact with the vapor and/or liquid during its use in the refining and dewaxing of mineral oil   | A,B,D                    | Process enclosure; local exhaust ventilation; personal protective equipment (goggles, respiratory protective devices, impervious gloves and clothing |

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