

Occupational Health Guideline for Allyl Alcohol

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CH}_2=\text{CHCH}_2\text{OH}$
- Synonyms: 2-Propenol; 2-propen-1-ol; vinyl carbinol
- Appearance and odor: Colorless liquid with an odor like mustard.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for allyl alcohol is 2 parts of allyl alcohol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 5 milligrams of allyl alcohol per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Allyl alcohol can affect the body if it is swallowed, is inhaled, or comes in contact with the skin or eyes.

• Effects of 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.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to allyl alcohol.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to allyl alcohol at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from allyl alcohol exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of allyl alcohol might cause exacerbation of symptoms due to its irritant properties.

—Skin disease: Allyl alcohol can cause skin burns. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—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.

—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.

—Eye disease: Because allyl alcohol is reported to cause eye injury, those with pre-existing eye diseases may be at increased risk from exposure.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of 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

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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underlying tissue and gastrointestinal 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.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 58
2. Boiling point (760 mm Hg): 97 C (206 F)
3. Specific gravity (water = 1): 0.9
4. Vapor density (air = 1 at boiling point of allyl alcohol): 2.0
5. Melting point: -129 C (-200 F)
6. Vapor pressure at 20 C (68 F): 17.2 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions

8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
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.

• Flammability

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. Extinguishant: Alcohol foam, dry chemical, carbon dioxide

• Warning properties

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

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

3. 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.

4. 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.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-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).

• Method

Sampling and analyses may be performed by collection of allyl alcohol vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure allyl alcohol may be used. An analytical method for allyl alcohol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid allyl alcohol.

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact

with allyl alcohol vapor at or above a concentration of 25 ppm.

- Clothing contaminated with liquid allyl alcohol should be placed in closed containers for storage until it can be discarded or until provision is made 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 person performing the operation should be informed of allyl alcohol's hazardous properties.

- Where there is any possibility of exposure of an employee's body to liquid allyl alcohol, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Any clothing which becomes wet with or non-impervious clothing which becomes contaminated with liquid allyl alcohol should be removed immediately and not reworn until the allyl alcohol is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid allyl alcohol may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid allyl alcohol should be immediately washed or showered to remove any allyl alcohol.

- Eating and smoking should not be permitted in areas where liquid allyl alcohol is handled, processed, or stored.

- Employees who handle liquid allyl alcohol should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to allyl alcohol may occur and control methods which may be effective in each case:

Operation	Controls
Use in preparation of various allyl esters which serve as monomers and prepolymers; use in preparation of chemical derivatives used in perfumes, flavorings, and pharmaceuticals	Process enclosure; local exhaust ventilation; personal protective equipment
Use as a fungicide, herbicide, and nematicide	Personal protective equipment
Use in refining and dewaxing of mineral oil	Process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If allyl alcohol gets into the eyes, wash 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.

• Skin Exposure

If allyl alcohol gets on the skin, immediately flush the contaminated skin with water. If allyl alcohol soaks through the clothing, remove the clothing immediately and flush the skin with water. If there is skin irritation, get medical attention promptly.

• Breathing

If a person breathes in large amounts of allyl alcohol, move the exposed person to fresh air at once. When breathing is difficult, properly trained personnel may assist the affected person by administering oxygen. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When allyl alcohol has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the 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. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

- 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 evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Allyl alcohol should not be allowed to

enter a confined space, such as a sewer, because of the possibility of an explosion.

• 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 secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "Allyl Alcohol," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

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RESPIRATORY PROTECTION FOR ALLYL ALCOHOL

Condition	Minimum Respiratory Protection* Required Above 2 ppm
Vapor Concentration	
100 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a 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.
150 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 150 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.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of allyl alcohol; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 150 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

