

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND  
SUPPORTING DOCUMENTATION FOR

\*\*\* ALLYL GLYCIDYL ETHER \*\*\*

NIOSH/OSHA Draft Technical Standard  
and Supporting Documentation for ALLYL GLYCIDYL ETHER

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 GLYCIDYL ETHER.

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 exposure of employees to airborne concentrations of allyl glycidyl ether (AGE) not in excess of 10 parts per million (ppm) (45 milligrams per cubic meter (mg/M3)) during any 15-minute period during an eight-hour work shift, as stated in \$1910.1000, Table Z-1.

(2) "Action level" means one-half of the permissible exposure for allyl glycidyl ether averaged over an eight-hour work shift.

(b) Initial determination and exposure measurement. (1) Each employer who has a place of employment in which allyl glycidyl ether is released into the workplace air shall determine if there is any possibility that any employee may be exposed to airborne concentrations of allyl glycidyl ether above the permissible level. The initial determination shall be made each time there is a change in production, process, or control measures which may result in an increase in airborne concentrations of allyl glycidyl ether.

(2) A written record of the initial 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 glycidyl ether;

(ii) Any measurements of allyl glycidyl ether taken;

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

(iv) Date of initial determination, work being performed at the time, location within work site, and employees considered.

(3) If the employer determines that any employee may be exposed to allyl glycidyl ether above the permissible exposure, 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 glycidyl ether above the action level, the employer shall:

(i) Identify all employees who may be exposed above the permissible 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 glycidyl ether above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every three months.

(6) If an employee exposure measurement reveals that an employee is exposed to allyl glycidyl ether 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 glycidyl ether above the permissible exposure. The employee shall also be notified of the results of the exposure measurements and of the corrective action being taken to reduce the exposure to 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 glycidyl ether

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below the action level, the employer may terminate measurement for the employee.

(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 percent, of not less than that given in Table 1.

Table 1

| Concentration | Required Accuracy<br>(Percent of True Value) |
|---------------|----------------------------------------------|
|---------------|----------------------------------------------|

|                            |      |
|----------------------------|------|
| Above permissible exposure | ± 25 |
|----------------------------|------|

|                                  |  |
|----------------------------------|--|
| At or below permissible exposure |  |
|----------------------------------|--|

|                            |      |
|----------------------------|------|
| and above the action level | ± 35 |
|----------------------------|------|

|                              |      |
|------------------------------|------|
| At or below the action level | ± 50 |
|------------------------------|------|

(d) Compliance. (1) No employee shall be exposed to allyl glycidyl ether above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of allyl glycidyl ether 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 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. (i) When local exhaust is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity or static pressure, 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 glycidyl ether.

(ii) In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving allyl glycidyl ether shall be classified as A-3 at 21 degrees C (70 degrees F).

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

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- (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 not feasible; or
- (iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of allyl glycidyl ether to at or below the permissible exposure; or
- (iv) For operations which require entry into tanks or closed vessels; or
- (v) 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. When an employee informs his employer that he is experiencing eye irritation from allyl glycidyl ether while wearing a respirator allowed in Table 2, the employer shall provide and ensure that the employee use an equivalent respirator with a full facepiece, helmet or hood.

TABLE 2     RESPIRATORY PROTECTION FOR ALLYL GLYCIDYL ETHER (AGE)

| CONDITION                                                            | PERMISSIBLE RESPIRATORY PROTECTION*                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -----                                                                |                                                                                                                                                                                                                                                                                                |
| Vapor Concentration                                                  |                                                                                                                                                                                                                                                                                                |
| 100 ppm or less                                                      | Any chemical cartridge respirator with an organic vapor cartridge(s).                                                                                                                                                                                                                          |
|                                                                      | Any supplied-air respirator.                                                                                                                                                                                                                                                                   |
|                                                                      | Any self-contained breathing apparatus.                                                                                                                                                                                                                                                        |
| 270 ppm or less                                                      | A chemical cartridge respirator with a full facepiece and 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.                                                                                                                                                                                                                                  |
| Greater than 270 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. |

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|               |                                                                                                                       |
|---------------|-----------------------------------------------------------------------------------------------------------------------|
| 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.<br>Any escape self-contained breathing apparatus.           |

\* Use of supplied-air suits may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of allyl glycidyl ether. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitation and potential life endangering characteristics of supplied-air suits. Where supplied-air suits are used above a concentration which may be immediately dangerous to life and health (270 ppm), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

(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 glycidyl ether.

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

(3) For the purpose of compliance with § 1910.157, allyl glycidyl ether 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 glycidyl ether shall be Class I, Group C.

(5) For the purpose of compliance with § 1910.106, liquid allyl glycidyl ether is classified as a Class II combustible liquid.

(6) Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).

(7) Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d).

(8) Where a fan is located in ductwork and where allyl glycidyl ether is present in the ductwork in concentrations greater than 5000 ppm, 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.

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

(10) Allyl glycidyl ether shall be stored so as not to come in contact with strong oxidizers.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment

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necessary to prevent skin contact with liquid allyl glycidyl ether where skin contact may occur. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

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

(3) Employers shall ensure that non-impervious clothing which becomes contaminated with allyl glycidyl ether be removed promptly and not reworn until the allyl glycidyl ether is removed from the clothing.

(4) Employers shall provide and ensure that employees use splash-proof safety goggles which comply with § 1910.133(a)(2)-(a)(6) where there is any possibility of liquid allyl glycidyl ether contacting the eyes.

(5) Where there is any possibility that an employee's eyes may be exposed to liquid allyl glycidyl ether, employers shall provide an eye-wash facility within the immediate work area for emergency use.

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

(2) Liquid allyl glycidyl ether shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive vapors are permitted.

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

(2) Employers shall ensure that employees who handle liquid allyl glycidyl ether wash their hands thoroughly before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which allyl glycidyl ether 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 glycidyl ether above the action level without regard to the use of respirators, or employees who may have skin contact or who may have any possibility of eye contact with liquid allyl glycidyl ether, or employees who work where allyl glycidyl ether presents a fire or explosion hazard shall annually:

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

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

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

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

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

(j) Medical surveillance. (1) The employer shall provide 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) Each employer who has employees exposed to airborne concentrations of allyl glycidyl ether above the action level, without regard to the use of respirators, or employees who may have skin contact or who may have any possibility of eye contact with liquid allyl glycidyl ether shall obtain information as to whether such employee has a history of any of the following medical conditions:

- (i) Chronic lung disease; and
- (ii) Skin disease.

(3) The employer shall provide a medical examination for the employee if:  
(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to allyl glycidyl ether which are listed in Appendix A which the employee suspects are caused by exposure to allyl glycidyl ether.

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

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

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

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

(iv) The results of any measurements 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 examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(i) The physician's written opinion by the examining physician shall specifically state: (A) Whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to allyl glycidyl ether;

(B) Any recommended limitations upon the employee's exposure to allyl glycidyl ether 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 the employee's employment.

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

(7) No employee shall be exposed to allyl glycidyl ether in such a way as would put the employee at increased risk of material impairment of his health from such exposure. The employer shall base this decision on any information available including the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to allyl glycidyl ether.

(9) 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 risk involved by refusal to be examined.

(10) 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) This 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 glycidyl ether.

(ii) This record shall include:

(A) The date of measurement;

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

(C) Sampling and analytical method used and evidence of their accuracy;

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

(E) Name 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.

(ii) This record shall include:

(A) Date of training;

(B) Name of employee trained;

(C) Content or scope of training provided.

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

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

(ii) This record shall include:

(A) The name of the employee;

(B) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(C) Any employee medical complaints relative to exposure to allyl glycidyl ether;

(D) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section.

(E) Physician's written opinion; and

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

(iii) This record shall be maintained for the duration of and for one year after termination 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) Each employee or former employee shall have access to the exposure determination and exposure measurement records required to be maintained by this section which indicate his own exposure to allyl glycidyl ether.

(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 each employee or his representative an opportunity to observe any measurement of his exposure to allyl glycidyl ether which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to allyl glycidyl ether 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 glycidyl ether that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for allyl glycidyl ether is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent the information supplements this regulation for allyl glycidyl ether, it is advisory in nature.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET  
FOR ALLYL GLYCIDYL ETHER (AGE)

I. SUBSTANCE IDENTIFICATION

- A. Substance: Allyl glycidyl ether (AGE)
- B. Permissible Exposure: 10 parts of allyl glycidyl ether per million parts of air (ppm) (45 milligrams of allyl glycidyl ether per cubic meter of air (mg/M3)) shall not be exceeded during any 15 minute period during an eight-hour work shift.
- C. Appearance and Odor: Colorless liquid with a strong odor

II. HEALTH HAZARD DATA

- A. Ways in which the chemical affects your body: Allyl glycidyl ether can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it. It may enter your body through your skin.
- B. Effects of Overexposure:
  - 1. Exposure to allyl glycidyl ether vapor or liquid has caused a skin rash with itching and swelling. Repeated exposure may produce an allergic skin rash. In animal experiments allyl glycidyl ether has caused irritation of the eyes and nose. It has also caused irritation of the lungs with severe breathing difficulties which are sometimes delayed in onset. In addition, animal experiments have shown that allyl glycidyl ether may cause drowsiness and unconsciousness.
  - 2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to allyl glycidyl ether.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If liquid allyl glycidyl ether 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 liquid allyl glycidyl ether gets on your skin, promptly wash the contaminated skin with water. If liquid allyl glycidyl ether soaks through your clothing, remove the clothing promptly and wash the skin with water. If irritation is present after washing, get medical attention.
- C. Breathing: If you or any other person breathes in large amounts of allyl glycidyl ether move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

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- D. Swallowing: When liquid allyl glycidyl ether has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.
- 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 emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. Respirators: Respirators are not the best way to control exposure to allyl glycidyl ether. 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 their use is required. If you can smell allyl glycidyl ether 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 Suits: In some work situations the wearing of impervious coverings such as acid suits may be necessary. Your employer should instruct you in their proper use and operation.
- C. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent skin contact with liquid allyl glycidyl ether where skin contact may occur. Replace or repair impervious clothing that has developed leaks.
- D. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquid allyl glycidyl ether contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Allyl glycidyl ether is a combustible liquid. Its vapors can form explosive mixtures with air at elevated temperatures.
- B. Allyl glycidyl ether must be stored in tightly closed containers in a cool, well ventilated area away from strong oxidizers.
- C. Sources of ignition such as smoking and open flames are prohibited wherever allyl glycidyl ether is handled, used or stored in a manner that could create a potential fire or explosion hazard.

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- D. You must promptly remove any non-impervious clothing that becomes contaminated with allyl glycidyl ether and this clothing must not be reworn until the allyl glycidyl ether is removed from the clothing.
- E. If your skin becomes contaminated with allyl glycidyl ether, you must promptly wash or shower to remove any allyl glycidyl ether from your skin.
- F. If you handle allyl glycidyl ether, you must wash your hands thoroughly before eating, smoking or using toilet facilities.
- G. Fire extinguishers and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them.
- H. Ask your supervisor where allyl glycidyl ether is used in your work area and for any additional 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 glycidyl ether. In addition, your employer must instruct you in the safe use of allyl glycidyl ether, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to allyl glycidyl ether. 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 the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment, and for a period of one year following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
- D. Your employer must give you a copy of the physicians written opinion for any physical examination required by this standard.

NOTE: The information contained in the following appendix for allyl glycidyl ether is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent the information supplements this regulation for allyl glycidyl ether, it is advisory in nature.

APPENDIX B

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SUBSTANCE TECHNICAL GUIDELINES  
FOR ALLYL GLYCIDYL ETHER (AGE)

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: AGE; 1-allyloxy-2,3-epoxypropane
2. Formula:  $\text{CH}_2=\text{CHCH}_2\text{OCH}_2\text{CHOCH}_2$
3. Molecular weight: 114

B. Physical Data

1. Boiling point (760 mm Hg): 154 C (309 F)
2. Specific gravity (water = 1): 0.97
3. Vapor density (air = 1 at boiling point of allyl glycidyl ether): 4
4. Melting point: -100 C (-148 F)
5. Vapor pressure at 20 C (68 F): 2 mm Hg
6. Solubility in water, grams of allyl glycidyl ether per 100 grams of water (68 F): 14.1
7. Evaporation rate (butyl acetate = 1): Data not available
8. Appearance and odor: Colorless liquid with a strong odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 57.2 C (135 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishing media: Dry chemical, carbon dioxide, alcohol
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Allyl glycidyl ether is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where allyl glycidyl ether is used, handled or stored in a manner that could create a potential fire or explosion hazard. Allyl glycidyl ether vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at location remote from the site at which allyl glycidyl ether is handled.
7. For purposes of complying with the requirements of 29 CFR 1910.106, allyl glycidyl ether is classified as a Class II combustible liquid. For example, 5000 ppm is one situation in which allyl glycidyl ether 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 glycidyl ether shall be Class I, Group C.

B. Reactivity

1. Conditions contributing to instability: Containers may burst at elevated temperatures.

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

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If allyl glycidyl ether 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. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber. Allyl glycidyl ether must not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of allyl glycidyl ether vapors are permitted.
- 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 glycidyl ether 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.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. EXPOSURE ABOVE THE ACTION LEVEL:
  1. Eight-Hour Exposure Evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or 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). Sampling and Analysis under this section 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 must determine the concentration of allyl glycidyl ether to plus or minus 35%.
  2. Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of allyl glycidyl ether. Each

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measurement should consist of a fifteen (15) minute sample or series of consecutive samples totaling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. When sampling for peak or ceiling exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. 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 glycidyl ether to plus or minus 25%.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set V" (Order number XXXXXXXXXX).
- 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 glycidyl ether in tightly closed containers in a cool, well ventilated area.
- B. Use of supplied-air suits or other impervious coverings (such as acid suits) may be necessary to prevent skin irritation from allyl glycidyl ether. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.
- C. Employers should advise employees of all areas and operations where their exposure to allyl glycidyl ether could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to allyl glycidyl ether is likely to occur are: During its production and use in the preparation of epoxy resins, or as a reactive diluent in the formulation of epoxy resin preparations; and during use as a copolymer.

NOTE: The information contained in the following appendix for allyl glycidyl ether is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing

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obligations. To the extent the information supplements this regulation for allyl glycidyl ether, it is advisory in nature.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Allyl glycidyl ether (AGE) vapor and liquid cause dermatitis; in animals at high concentrations the vapor causes eye and nose irritation, pulmonary edema, and narcosis. In rats, the LC50 for 8 hours was 670 ppm; effects were lacrimation, nasal discharge, dyspnea, and narcosis; death was usually caused by pulmonary edema and pneumonitis. In rats repeatedly exposed to 600 ppm for 8 hours daily, effects were pronounced irritation of the eyes and respiratory tract; more than half of the rats developed corneal opacity; at necropsy, after 25 exposures, pulmonary findings were inflammation, bronchiectasis, emphysema, and bronchopneumonia. The liquid dropped into the eye of a rabbit caused severe but reversible conjunctivitis, iritis, and corneal opacity. Workers exposed to the vapor and/or liquid complained of dermatitis with itching and swelling; skin sensitization has occurred.

III. SIGNS AND SYMPTOMS

Dermatitis; by analogy to effects caused at high levels in animals, it may cause eye and nose irritation; pulmonary irritation and edema; narcosis.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation and administer oxygen if indicated. Consideration should be given to hospitalization and observation for the possible delayed onset of pulmonary edema.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

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Allyl glycidyl ether causes dermatitis and is reported to cause skin sensitization. At high levels it causes pulmonary edema and narcosis in animals. Skin absorption is known to occur. It is important that the physician become familiar with plant operating conditions in which exposure to allyl glycidyl ether 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

Routine medical histories and physical examinations 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 allyl glycidyl ether exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Chronic respiratory disease -- Allyl glycidyl ether causes respiratory irritation in animals. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of allyl glycidyl ether might cause exacerbation of symptoms due to its irritant properties.
2. Skin disease -- Allyl glycidyl ether is a skin sensitizer. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

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.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Allyl Glycidyl Ether (AGE)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 9.
2. Hygienic Guide Series: "Allyl Glycidyl Ether," American Industrial Hygiene Association Journal, 26:89-91, 1965.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, -1963, pp. 1598-1600.
4. Hine, C.H., et al: "The Toxicology of Glycidol and Some Glycidyl Ethers," A.M.A. Archives of Industrial Health, 13:250-264, 1956.

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REFERENCES AND SOURCES  
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1910.1000

- (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
- (f) Personal Protective Equipment, and, (h) Sanitation  
Eye: Grant, "Toxicology of the Eye;" Patty, "Industrial Hygiene and Toxicology;" ACGIH, "Documentation of the Threshold Limit Values for Substances in Workroom Air"  
Skin: Sax, "Dangerous Properties of Industrial Materials;" Patty, "Industrial Hygiene and Toxicology;" ACGIH, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" Deichmann and Gerarde, "Toxicology of Drugs and Chemicals"  
Ingestion: Sax, "Dangerous Properties of Industrial Materials;" Patty, "Industrial Hygiene and Toxicology;" ACGIH, "Documentation of the Threshold Limit Values for Substances in Workroom Air;" Chris "NIOSH Toxic Substances List"

COMMENTS

Eye - Classification: 1

Output statement numbers: 9 and 13 Modified

Exceptions: None

According to Grant, AGE "causes severe but reversible corneal damage when dropped on a rabbits eye. High vapor concentration produces corneal opacities in rats."

Patty states that the compound is "appreciably irritating and injurious to the eyes and skin" and resulted in a score of 72 with the Draize method.

The ACGIH regards AGE as a severe eye irritant and notes that "several cases of dermatitis and one case of eye irritation constitute the human data."

It is assigned a classification of 1 since it causes severe corneal damage and may cause corneal opacities.

Skin - Classification: 2

Output statement numbers: 2, 7a, 17g, 17i, 20a

Exceptions: Modified 2

Sax lists the compound as being an acute local irritant of high toxic hazard, and a chronic local allergen of moderate toxic hazard. He considers the acute systemic effects by skin absorption to be of slight toxic hazard.

The ACGIH reports that AGE is classified as a moderate primary skin irritant and has a percutaneous LD50 for rabbits of 2.55 g/kg.

Patty notes that "the compound is classified as moderately irritating. Studies on human subjects indicate that skin sensitization occurs readily." He adds that AGE is classified as slightly toxic after percutaneous application and that central nervous system depression is the predominant symptom of such administration.

Deichman and Gerarde, writing of epoxy compounds in general,

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report "following excessive body contact and development of contact dermatitis, these compounds may cause sensitization with symptoms similar to those produced by the amine curing agents."

AGE has a melting point of -148 degrees F and a boiling point of 309 degrees F. At 20 degrees C, it has a vapor pressure of 2 mm Hg and a 14.1% solubility in water. The flash point of the substance is 135 degrees F.

A classification of 2 is concluded to be adequate for this substance. It is cautioned, however, that the requirements resulting from this classification may not protect against sensitization in all workers.

Ingestion - Classification: 2

Output statement numbers: 20a

Exceptions: None

Sax lists the acute systemic effects of ingestion of AGE as being of slight toxic hazard.

The ACGIH reports intragastric LD50 values of 0.39 and 1.60 g/kg respectively for mice and rats. The predominant toxicologic activity after intragastric administration is noted to be CNS depression.

Patty states that AGE is classified as slightly toxic after oral administration. He adds that "administration of the compound to rats and mice orally produced moderate depression and dyspnea within 15 to 19 minutes. Deaths occurred in 4 hours to 5 days. LD50 for mice was 0.39 and for rats, 160 g/kg. At autopsy hypotonicity of the enteric tract and extensive adhesions of the stomach wall to adjacent tissues were noted. No characteristic microscopic pathology occurred, although occasionally the liver showed focal areas of necrosis."

Christensen lists an oral LD50 for the rat of 922 mg/kg.

A classification of 2 is concluded to be appropriate for AGE if statement 2 is modified to prevent skin contact because of sensitization.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Shell Chemical Co., Material Safety Data Sheet (Shell)

N.M. Bikales (ed.), "Encyclopedia of Polymer Science and Technology,"

Interscience - Wiley, New York, 1967, vol. 6, p. 170 (Bik)

Alcolac Corp., Technical Bulletin (Alc)

Sources of data items used:

- |    |    |    |                                      |
|----|----|----|--------------------------------------|
| I. | A. | 1. | Synonyms: Shell                      |
|    |    | 2. | Formula: Shell                       |
|    |    | 3. | Molecular weight: ADL                |
|    | B. | 1. | Boiling point: Shell                 |
|    |    | 2. | Specific gravity: Shell, Alc         |
|    |    | 3. | Vapor density: Shell                 |
|    |    | 4. | Melting point: Alc                   |
|    |    | 5. | Vapor pressure: Shell                |
|    |    | 6. | Solubility in water: Alc             |
|    |    | 7. | Evaporation rate: Data not available |

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- II. A. 8. Appearance and odor: Shell
- 1. Flash point: Shell
- 2. Autoignition temperature: Data not available
- 3. Flammable limits: Data not available
- 4. Extinguishing media: Shell
- 5. Special fire fighting procedures: ADL
- 6. Unusual fire and explosion hazards: Shell, ADL
- B. 1. Conditions contributing to instability: ADL
- 2. Incompatibilities: ADL
- 3. Hazardous decomposition products: None
- 4. Special precautions: ADL
- III. A. Steps if released or spilled: Shell, ADL
- C. Waste disposal method: Shell, ADL
- V. Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- "Allyl Glycidyl Ether," Hygienic Guide Series, American Industrial Hygiene Assoc., January - February 1965 (Hygienic Guide)
- "Allyl Glycidyl Ether," Material Safety Data Sheet, Shell Chemical Company, Oct. 1971 (MSDS)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, 2nd edition, vol. 8, 1965 (K-O)
- Lee, H. and Neville, K., "Epoxy Resins," McGraw-Hill Book Co., Inc., 1957 (Lee)
- Lee, H. and Neville, K., "Handbook of Epoxy Resins," McGraw-Hill Book Co., Inc., 1967 (Lee Handbook)
- Mark, H. F., Gaylord, N. G., Bikales, N. M., "Encyclopedia of Polymer Science and Technology," Interscience Publishers, vol. 6, 1967 (Poly Sci)
- Patty, F. A., "Industrial Hygiene and Toxicology," vol. II, Interscience Publishers, 1962 (Patty)

References for Specific Use/Exposure

- 1. Lee, Poly Sci
- 2. Lee Handbook, Poly Sci
- 3. K-O, Patty
- 4. MSDS

References for Specific Control Methods

Hygienic Guide and MSDS were the references used in all the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Allyl glycidyl ether (AGE)

D. O. L. STANDARD: 10 ppm shall not be exceeded

WARNING PROPERTIES:

Odor Threshold: The AIHA Hygienic Guides state that AGE is a "clear, colorless, mobile liquid with a characteristic sweet odor detectable at room temperature at less than 10 ppm."

Eye Irritation Level: Grant states that "high vapor concentration produces corneal opacities in rats. Low vapor concentrations produce such severe eye and respiratory irritation that this serves as adequate warning against dangerous exposures."

For the purposes of this standard, half-facepiece respirators are permitted up to 100 ppm unless eye irritation occurs. If eye

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irritation occurs, a full facepiece respirator must be worn. The Documentation of TLV's notes that "260 ppm caused very slight irritation of eyes" of laboratory animals.

Evaluation of Warning Properties: Because of its low odor threshold, AGE is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 270 ppm

Basis for IDLH Value: The chosen IDLH is based upon the 4-hour, mouse LC50 of 270 ppm reported in the Documentation of TLV's, in the AIHA Hygienic Guides and in Patty.

Other Toxicological Information: The Documentation of TLV's states that "the only reported data on AGE are those of Hine, et al., in which extensive animal studies and limited human exposures are described. Several cases of dermatitis and one case of eye irritation constitute the human data. In animals, AGE is classified as a moderate primary skin irritant and a severe eye irritant. Systemic toxicity to rats was observed after 50 daily, seven-hour exposures to 260, 400, 600 and 900 ppm, manifested by decreased weight gain at 260 ppm, and high mortality at 600 and 900 ppm. Kidneys of animals exposed to 400 ppm showed excessive kidney/body weight ratios. 260 ppm caused very slight irritation of eyes and slight respiratory distress. At high levels corneal opacities resulted, and severe respiratory difficulties quickly developed. Lungs at necropsy or autopsy showed bronchopneumonia emphysema, bronchiectasis, pneumonitis, and hemorrhage. Other findings were mottled discoloration of liver, enlarged adrenal glands. Two animals exposed to 900 ppm had necrotic spleens. The LC50 for mice (four hours) was 270 ppm, and for rats (eight hours) 670 ppm. Intragastric LD50 values were 0.39 and 1.60 g/kg respectively for mice and rats, while the percutaneous LD50 for rabbits was 2.55 g/kg. Predominant toxicologic activity was depression of the central nervous system after intragastric administration.

"Effects observed in man are primary irritation and occasional sensitization. The potential exists for cross sensitization with other epoxy agents. The TLV of 5 ppm is believed to be sufficiently low to prevent primary irritation, but may not protect against sensitization in all workers."

Both Patty and the AIHA Hygienic Guides report information similar to that given in the Documentation of TLV's.

Concerning skin contact with AGE, the Hygienic Guides state that "penetration through the intact skin was observed in rabbits using the 24-hour 'cuff' application method: death was produced in one week at a dosage of 0.5 gm/kg and death occurred overnight at a level of 1.0 gm/kg. Workers that were accidentally exposed to the vapors and/or liquid complained of dermatitis, itching, and swelling. Skin sensitization has occurred in susceptible individuals."

LFL: Data not available

-VAPOR PRESSURE AT 20 C: 2 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 2630 ppm

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|    | Use/Exposure                                                                                                                                                                                                                                                                                                      | Principal Route<br>of Entry | Currently Used<br>Control Methods                                                                                               |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| 1. | Inhalation of vapor and skin contact with liquid during use as a reactive diluent in the formulation of epoxy resins. It serves as a chain stopping element to reduce crosslinking density and as a free-flowing liquid to reduce the viscosity of the resin (laminates, adhesive formulations, silane finishes). | A,B,D                       | Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)                                 |
| 2. | Inhalation of vapor and skin contact with liquid during use as a copolymer (with propylene oxide to produce rubbers that permit vulcanization by sulfur; with vinyl acetate for surface coatings; with vinyl chloride, allyl chloride, acrylonitrile in epoxy resins)                                             | A,B,D                       | Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)                                 |
| 3. | Inhalation of vapor and skin contact with liquid during the synthesis and processing of allyl glycidyl ether (condensation of allyl alcohol and epichlorohydrin with subsequent dehydrochlorination; epoxidization of allyl ether with peracetic acid)                                                            | A,B,D                       | Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)                                 |
| 4. | Inhalation of vapor and skin contact with liquid during cleaning and maintenance of storage vessels and equipment or during clean up of accidental spills                                                                                                                                                         | A,B,D                       | Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing, respiratory protective devices) |

A -- Inhalation

B -- Skin and eye contact resulting in localized irritation

C -- Ingestion

D -- Skin contact resulting in absorption and subsequent systemic

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poisoning