

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** EPICHLOROHYDRIN ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for EPICHLOROHYDRIN

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 EPICHLOROHYDRIN.

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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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. American Conference of Governmental Industrial Hygienists: "1,1-Dichloroethane (Ethylidene Chloride)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 310.
2. Hygienic Guide Series: "1,1-Dichloroethane (Ethylidene Chloride)," American Industrial Hygiene Association Journal, 32:6771, 1971.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1279-1280.

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(a) Definitions.

(1) "Permissible exposure" means inhalation of epichlorhydrin in concentrations not in excess of 5 parts per million (ppm) (19 milligrams per cubic meter, mg/m³) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

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

(b) Exposure determination and measurement.

(1) Each employer who has a place of employment in which epichlorhydrin is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of epichlorhydrin 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 epichlorhydrin.

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

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

(ii) Any measurements of epichlorhydrin taken;

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

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

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

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

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

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

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

(6) If an employee exposure measurement reveals that an employee is exposed to epichlorhydrin 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 epichlorhydrin above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

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

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

(c) Methods of measurement.

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

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

Table 1

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

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

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

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

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

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

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

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

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

(iv) In emergencies.

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

TABLE 2 RESPIRATORY PROTECTION FOR EPICHLOROHYDRIN

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
50 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
250 ppm or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 250 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 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. (Supplied-air suits may be necessary)
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 and acid gases. Any escape self-contained breathing apparatus.

(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.

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(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 epichlorohydrin.

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

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

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

(6) Where a fan is located in ductwork and where epichlorohydrin is present in the ductwork in concentrations greater than 9500 ppm (approximately 25% of the lower flammable limit), the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

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

(8) Epichlorohydrin shall be stored so as not to come in contact with chemically active metals.

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

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

(3) Where there is any possibility of exposure of an employee's body to liquid epichlorohydrin, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

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

(5) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply with § 1910.133(a)(2)-(a)(6) where there is any possibility of liquid epichlorohydrin contacting the eyes.

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

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

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

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with liquid epichlorohydrin immediately wash or shower with soap or mild detergent and water to remove any epichlorohydrin from the skin.

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

(3) Employers shall ensure that employees who handle liquid epichlorohydrin wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which epichlorohydrin 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 epichlorohydrin above the action level or employees who may have skin or eye contact with liquid epichlorohydrin, or employees who work where it presents a potential fire or explosion hazard, or where an accidental spill of epichlorohydrin may occur, shall annually:

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

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

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

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

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

(i) A medical history and physical examination with emphasis on the lungs.

(ii) 14" x 17" chest roentgenogram.

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

(iv) Urinalysis to include specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

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

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

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

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

(iv) A record of the results of urinalysis.
testing.

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

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

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

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

(iv) Urinalysis (see paragraph (j)(2)(iv) of this section).

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

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

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

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

(iv) A record of the results of urinalysis.

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

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

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

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

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

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

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

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

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

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

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

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

(8) No employee shall be exposed to liquid epichlorhydrin or airborne concentrations of epichlorhydrin in such a way as would put the employee at

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increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

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

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

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

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

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

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

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

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

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

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

(ii) This record shall include:

(A) The date of measurement;

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

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

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

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

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

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

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

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(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 and social security number of employee trained;

(C) Content or scope of training provided.

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

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

(ii) The record shall include:

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

(B) Any employee medical complaints relative to exposure to epichlorhydrin;

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

(D) Physician's written opinion; and

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

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

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

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

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

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

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

(iii) Record the results obtained.

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

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR EPICHLOROHYDRIN

I. SUBSTANCE IDENTIFICATION

- A. Substance: Epichlorohydrin
- B. Permissible Exposure: 5 parts of epichlorohydrin per million parts of air (ppm) or 19 milligrams of epichlorohydrin per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.
- C. Appearance and Odor: Colorless liquid with an irritating, chloroform-like odor.

II. HEALTH HAZARD DATA

- A. Ways in Which the Chemical Affects Your Body: Epichlorohydrin can affect your body if you inhale it or if it comes in contact with your eyes and skin or if you swallow it. It may be absorbed through the skin.
- B. Effects of Overexposure:
 - 1. Short-Term Exposure: Epichlorohydrin may cause irritation of the eyes, respiratory tract and skin. Nausea and vomiting may also occur. Coughing, difficult breathing and a blue coloration of the skin may be present. Liquid epichlorohydrin may produce blistering and deep-seated pain on contact with the skin. The liquid is highly irritating to the eyes. Breathing difficulty may occur several hours after exposure. You may become sensitized to this chemical so that you cannot tolerate even very small amounts.
 - 2. Long-Term Exposure: Repeated or prolonged skin contact with epichlorohydrin may cause skin burns. Repeated or prolonged contact with this chemical might also cause liver, lung and kidney injury.
 - 3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to epichlorohydrin.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If epichlorohydrin 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 epichlorohydrin gets on your skin, immediately flush the contaminated skin using soap or mild detergent and water. If epichlorohydrin soaks through your clothing, remove the clothing immediately and flush the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

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- C. Breathing: If you or any other person breathes in large amounts of epichlorohydrin, 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.
- D. Swallowing: When epichlorohydrin 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 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 epichlorohydrin. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where there use is required. If you can smell epichlorohydrin 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. Supplied-air Suits: In some work situations the wearing of supplied-air suits may be necessary. Your employer should instruct you in their proper use and operation.
- C. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent any possibility of skin contact with liquid epichlorohydrin. Replace or repair impervious clothing that has developed leaks.
- D. Eye Protection: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) if there is any possibility of liquid epichlorohydrin contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Epichlorohydrin is a combustible liquid and its vapors can form explosive mixtures with air at elevated temperatures.

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- B. It must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong oxidizers, strong acids, caustics, chemically active metals and chlorides of iron and aluminum.
- C. Sources of ignition such as smoking and open flames are prohibited wherever epichlorohydrin is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- D. You must use non-sparking tools when opening or closing metal containers of epichlorohydrin, and containers must be bonded and grounded when pouring or transferring liquid epichlorohydrin.
- E. If your skin becomes contaminated with liquid epichlorohydrin, you must immediately wash or shower using soap or mild detergent and water to remove any epichlorohydrin from the skin.
- F. You must immediately remove any non-impervious clothing that becomes contaminated with liquid epichlorohydrin and this clothing must not be reworn until the epichlorohydrin is removed from the clothing.
- G. You must not eat or smoke in areas where liquid epichlorohydrin is handled, processed or stored.
- H. If you handle liquid epichlorohydrin, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.
- I. 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.
- J. Ask your supervisor where epichlorohydrin is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

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

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR EPICHLOROHYDRIN

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 1-chloro-2,3-epoxypropane;
2-chloropropylene oxide; gamma-chloropropylene oxide
2. Formula: C_3H_5OCl
3. Molecular weight: 92.5

B. Physical Data

1. Boiling point (760 mm Hg): 115 C (239 F)
2. Specific gravity (Water = 1): 1.18
3. Vapor density (air = 1 at boiling point of epichlorohydrin): 3.19
4. Melting point: -58 C (-72 F)
5. Vapor pressure at 20 C (68 F): 13 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 6.4
7. Evaporation rate (butyl acetate = 1): 1.35
8. Appearance and odor: Colorless liquid with an irritating, chloroform-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 37.8 C (100 F) (closed cup)
2. Autoignition temperature: 415.6 C (780 F)
3. Flammable limits in air, % by volume: Lower: 3.8;
Upper: 21.0
4. Extinguishing media: Dry chemical, alcohol foam, carbon dioxide
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: Epichlorohydrin is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where epichlorohydrin is used, handled or stored in a manner that may create a potential fire or explosion hazard. Epichlorohydrin vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at locations remote from the site at which epichlorohydrin is handled. Epichlorohydrin may polymerize and burst its containers when heated in a fire.
7. For purposes of complying with the requirements of 29 CFR 1910.106, epichlorohydrin is classified as a Class II combustible liquid. For example, above 9500 ppm,

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one-fourth of the lower flammable limit, is one situation in which epichlorohydrin 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 epichlorohydrin shall be Class I Group C.

B. Reactivity

1. Conditions contributing to instability: Temperatures above 325 C (617 F) will cause epichlorohydrin to polymerize.
2. Incompatibilities: Contact with strong acids, caustics, zinc, aluminum, chlorides of iron and aluminum and strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapor (such as phosgene, hydrogen chloride and carbon monoxide) may be released in a fire involving epichlorohydrin.
4. Special precautions: Epichlorohydrin will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

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

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Epichlorohydrin 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: Epichlorohydrin may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

IV. MONITORING AND MEASUREMENT PROCEDURES

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

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instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of epichlorohydrin to plus or minus 35%.

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

V. MISCELLANEOUS PRECAUTIONS

- A. Store epichlorohydrin in tightly closed containers in a cool, well ventilated area.
- B. High exposures to epichlorohydrin can occur when transferring from one container to another.
- C. Non-sparking tools must be used to open and close metal epichlorohydrin containers. These containers must be effectively grounded and bonded prior to pouring.
- D. Large storage tanks should be padded with an inert gas such as nitrogen to inhibit polymerization.
- E. Employers should advise employees of all areas and operations where exposure to epichlorohydrin could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to epichlorohydrin is likely to occur are: during its use as an intermediate in the manufacture of epoxy resins, ion-exchange resins, glycerol and glycidol derivatives; during its use as a stabilizer for rubbers and insecticides; during textile fiber processing; and during its production.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Epichlorohydrin vapor is a potent eye and respiratory irritant. The LC50 for rats was 500 ppm for 4 hours; the animals showed gradual development of cyanosis followed by muscular relaxation of the extremities but not narcosis. Rats exposed repeatedly to 120 ppm for 6 hour periods showed lung, liver, and kidney injury; some respiratory distress was observed at 56 ppm, while 9 ppm produced no effects. The liquid is markedly irritating when instilled in the eye and intensely irritating to the depilated skin of laboratory animals leading to widespread necrosis. In man, contact of the liquid with the skin produces at first a slight transient burning sensation which may be followed several hours later by blistering and pain in the region of contact; it is also highly irritating to the eyes. An occasional case of sensitization with resulting intolerance to very small quantities of the substance has been reported. At 25 ppm the odor is recognized by the majority of persons; one report indicated eye and nose irritation only at levels exceeding 100 ppm while another stated that 40 ppm at the site of a spill caused immediate eye, nose, and throat irritation. The earliest symptoms of intoxication may be referable to the gastrointestinal tract (nausea, vomiting, abdominal discomfort) or pain in the region of the liver; labored breathing, cough, and cyanosis may be evident; the onset of chemical pneumonitis may occur several hours after exposure. Subcutaneous injection of epichlorohydrin has been reported to cause sarcoma at the site of injection.

III. SIGNS AND SYMPTOMS

May cause nausea, vomiting, and abdominal pain; respiratory distress, cough, and cyanosis from heavier exposures; marked skin irritation with deep pain; eye irritation.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap and water. If swallowed and the person is conscious; induce vomiting. If overexposed, consideration should be given to hospitalization and observation of possible delayed onset of pulmonary edema or chemical pneumonitis. Give artificial resuscitation if indicated.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

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A. GENERAL

Most reported effects of epichlorhydrin are eye irritation and pain, irritation of the respiratory tract, and skin irritation and sensitization. It is important that the physician becomes familiar with plant operating conditions in which exposure to epichlorhydrin occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

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

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the eyes, respiratory system, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.
2. 14" x 17" chest roentgenogram -- Epichlorhydrin may cause lung damage. Surveillance of the lungs is indicated.
3. Pulmonary function testing of FVC and FEV (1 sec) -- Epichlorhydrin is a severe pulmonary irritant in animals.
4. Urinalysis -- Since kidney damage has also been observed from exposure, a urinalysis shall be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

C. PERIODIC EXAMINATIONS

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

References

1. American Conference of Governmental Industrial Hygienists: "Epichlorhydrin," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 98-99.
2. Hygienic Guide Series: "Epichlorhydrin," American Industrial Hygiene Association Journal, 22:511-513, 1961.

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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. 1622-1625.

4. Van Duuren, B.L. et al, "Carcinogenicity of Halo-Ethers. II. Structure-Activity Relationships of Analogs of Bis (chloromethyl) ether," Journal of National Cancer Institute, 48:1431-1439, 1972.

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REFERENCES AND SOURCES
EPICHLOROHYDRIN
1910.93

(e) Fire and Safety

- (1) Electrical - Classification based on "Fire Hazard Classification of Chemical Vapors Relative to Explosion-proof Electrical Equipment," H. Carhart et al, National Academy of Sciences, 1973, report to U. S. Coast Guard, report no. CG-D-92-74, p. 13.

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

Eye: Grant, "Toxicology of the Eye;" Hygienic Guide Series, "Epichlorohydrin"

Skin: Hygienic Guide Series, "Epichlorohydrin;" American Conference of Governmental Industrial Hygienists, "Documentation of the Threshold Limit Values;" Patty, "Industrial Hygiene and Toxicology;" Sax, "Dangerous Properties of Industrial Materials"

Ingestion: American Conference of Governmental Industrial Hygienists "Documentation of the Threshold Limit Values;" Dow Chemical Company Material Safety Data Sheet; Patty, "Industrial Hygiene and Toxicology," Sax, "Dangeous Properties of Industrial Materials"

COMMENTS

Eye - Classification: 1

Output statement numbers: 9, 13

Exceptions: None

Grant reports "test by application of a drop to rabbit eyes caused a mild and presumably reversible injury graded 4 on a scale of 1 to 10 after 24 hours." The Hygienic Guide terms the liquid "highly irritating" to the eyes. The Dow MSDS notes the "liquid markedly irritating and injurious" to the eyes. The substance is given a classification of 1. Since a rating of 5 on a scale of 1 to 10 represents severe eye injury from 0.02 ml in the eye, the grade of 4 is consistent with the comments of the Hygienic Guide and Dow. It signifies that 0.1 ml in the eye can produce severe injury.

Skin - Classification: 1

Output statement numbers: 1, 7a, 8a, 14i, 14g, 20a

Exceptions: Statement 6 replaced with 7a

According to the Hygienic Guide, "Liquid epichlorohydrin is reported to produce only a slight transient burning sensation on first contact with the skin; blistering and deep-seated pain in the contact area may occur several hours after the initial contact." The Guide also states that cases of sensitization have been reported. Repeated application of liquid to the skin of rats at a dose of 0.5 ml/kg resulted in "muscular paralysis (and) depressed respiration that led to death" according to the Documentation of TLV's. It is also noted that exposure results in "systemic toxicity from absorption of the liquid through the skin" and that "epichlorohydrin manifests cumulative action as a result of its nephrotoxicity." Patty lists a percutaneous LD50 for rabbits of 0.88

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ml/kg. Sax lists it as highly toxic locally and systemically following acute and chronic exposures, the latter resulting from skin absorption; it is also classified as a moderate allergen. A classification of 1 for this liquid is concluded to be justified. Its flashpoint is 100 F. Its vapor pressure at 20 C is 13 mm Hg. Statement 6 is replaced with 7a as this substance is a liquid and amounts which could get on clothing without an employee realizing that his clothing was contaminated would evaporate and should not pose a significant Ingestion - Classification: 1

Output statement numbers: 19, 20a

Exceptions: None

Repeated oral administration of 0.1 ml/kg to mice resulted in "muscular paralysis (and) depressed respiration that led to death," according to the Documentation of TLV's, which also notes that its action is cumulative. Dow Chemical data give a rabbit LD50 of 800 - 900 mg/kg. An oral rat LD50 of 900 mg/kg appears in Patty. The hazard of acute local and acute and chronic systemic exposures are rated high by Sax. Since the LD50's are low, its vapor pressure is low, and its effects are cumulative, the substance is given a classification of 1.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Union Carbide Corp., Material Safety Data Sheet (UCC)

Dow Chemical USA, "Epichlorohydrin" and Material Safety Data Sheet (Dow)

Shell Chemical Co., Technical Bulletins IC:69 - 16 and IC:70 - 18;

Material Safety Data Sheet (Shell)

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

Sources of data items used:

- I.
 - A.
 1. Synonyms: NFPA-325M; UCC
 2. Formula: UCC
 3. Molecular weight: UCC
 - B.
 1. Boiling point: NFPA-325M; UCC
 2. Specific gravity: UCC; Dow; Shell
 3. Vapor density: UCC
 4. Melting point: UCC; Shell
 5. Vapor pressure: UCC; Dow; Shell
 6. Solubility in water: UCC
 7. Evaporation rate: UCC
 8. Appearance and odor: NFPA-49
- II.
 - A.
 1. Flash point: Shell
 2. Autoignition temperature: NFPA-49; UCC
 3. Flammable limits: NFPA-49; Dow
 4. Extinguishing media: NFPA-49; Dow
 5. Special fire fighting procedures: NFPA-49; Dow
 6. Unusual fire and explosion hazards: NFPA-49
 - B.
 1. Conditions contributing to instability: UCC; Dow
 2. Incompatibilities: NFPA-49; UCC; Dow

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3. Hazardous decomposition products: NFPA-49
4. Special precautions: Dow
- III. A. Steps if released or spilled: NFPA-49; Dow
- C. Waste disposal method: UCC; Dow
- V. Miscellaneous precautions: NFPA-49; Dow
- VI. Common operations: Dow; Shell

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

- "Epichlorohydrin," American Conference of Government Industrial Hygienists, Hygienic Guide Series, December 1961 (Hygienic Guides)
- "Epichlorohydrin," Dow Chemical Company, Technical Bulletin (Dow Tech)
- "Epichlorohydrin," Hazard Process Index Hazard Entry No. 72, Contract HSM-99-73-62, National Institute of Occupational Safety and Health (HPI)
- "Epichlorohydrin," Material Safety Data Sheet, Dow Chemical Company, Midland, Michigan, January 17, 1972 (Dow)
- "Epichlorohydrin," Material Safety Data Sheet, Union Carbide (Union Carbide)
- Gage, J. C., "The Toxicity of Epichlorohydrin Vapour," British Journal of Industrial Medicine, 16:11 - 14, 1959 (Gage)
- Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 1st edition, 1954 (Chem Tech)
- Lee, H. and Neville, K., "Handbook of Epoxy Resins," McGraw-Hill, New York, 1967 (Lee and Neville)
- Plunkett, E. R., "Handbook of Industrial Toxicology," Chemical Publishing Co., Inc., 1966 (Plunkett)
- Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)

References for Specific Use/Exposure

HPI and Lee and Neville were the references used in numbers 1 - 3.

4. HPI, Chem Tech, SRI
5. HPI
6. Gage, Chem Tech
7. Gage, Chem Tech
8. CEH
9. Dow, Plunkett

References for Specific Control Methods

ACGIH Guides, Union Carbide and Dow were the references used for the Specific Control Methods in numbers 1 - 9.

RESPIRATOR TABLE DOCUMENTATION

PERMISSIBLE EXPOSURE: 5 ppm.

WARNING PROPERTIES: The AIHA Hygienic Guides state that 5 ppm epichlorohydrin, the permissible exposure limit, cannot be detected by odor. At 16 ppm, 4 humans "detected the presence of epichlorohydrin but only 2 could identify it." At 64 ppm all 4 humans could recognize the odor. In another investigation, half of a group of people detected 10 - 12 ppm, and within 5 minutes all of the subjects detected 25 ppm. According to the Hygienic Guides, "the threshold for nose and eye irritation was reported to be greater than 100 ppm." Since the warning properties of epichlorohydrin do not become evident until concentrations several times above the permissible exposure limit, epichlorohydrin is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

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EYE IRRITATION: Epichlorohydrin is an eye irritant. The AIHA Hygienic Guides State that the threshold for eye irritation has been reported to be greater than 100 ppm.

LFL: The lower flammable limit of epichlorohydrin is 38,000 ppm.

IDLH: 250 ppm.

IDLH BASIS: The AIHA Hygienic Guides do not give an IDLH concentration. Based upon the 4 - hour rat LCLO of 250 ppm reported in the NIOSH Toxic Substances List, an IDLH concentration of 250 ppm epichlorohydrin has been assumed for the purposes of this standard.

SUMMARY OF TOXICOLOGY:

According to Patty, epichlorohydrin causes CNS depression and irritation of the respirator tract. The cause of death in experimental animals from acute exposures to epichlorohydrin is specifically depression of the respiratory center. In repeated exposure studies, "the cumulative toxic action shown in animals is believed to be due to a nephrotoxic action."

In acute inhalation toxicity studies, the 4 - hour LC50's have been determined to be: 445 ppm for rabbits, 500 ppm for rats, and 561 ppm for guinea pigs. Also, a LC50 of 250 ppm has been determined for rats for an 8 - hour exposure. The NIOSH Toxic Substances List gives a 4 - hour LCLO of 250 ppm for rats. The LCLO is the "Lethal Concentration Low -- the lowest concentration of a substance, other than a LC50, in air which has been reported to have caused death in man or to have caused death in animals when they have been exposed for 24 hours or less."

Skin absorption may be a problem with epichlorohydrin. The Dow Chemical Company reports a skin absorption LD50 (rabbits) of 800 - 900 mg/kg in its Material Safety Data Sheet.

VAPOR PRESSURE AT 20 C: 13 mm.

SATURATED AIR CONCENTRATION: 17,000 ppm.

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USE/EXPOSURE AND CONTROL DOCUMENT

EPICHLOROHYDRIN

Principal Route
of Entry

Currently Used
Control Methods

- | Use/Exposure | Principal Route of Entry | Currently Used Control Methods |
|--|--------------------------|--|
| 1. Inhalation of vapor and skin contact with liquid during manufacture of DGEBA resins | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 2. Inhalation of vapor and skin contact with liquid during manufacture of epoxy novolac resins | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 3. Inhalation of vapor and skin contact with liquid during manufacture of phenoxy resins | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 4. Inhalation of vapor and skin contact with liquid during manufacture of glycerol and glycidol derivatives (used as plasticizers, stabilizers, solvents, dyestuff intermediates, surface active agents, and pharmaceuticals and as intermediates for further synthesis) | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 5. Inhalation of vapor and skin contact with liquid during manufacture of epichlorohydrin and epichlorohydrin-ethylene oxide rubber | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 6. Inhalation of vapor and skin contact with liquid during use as a stabilizer in manufacture of chlorinated rubber | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 7. Inhalation of vapor and skin contact with liquid during use as a stabilizer in manufacture of | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory |

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chlorinated insecticides

protective devices)

- | | | | |
|----|--|-------|--|
| 8. | Inhalation of vapor and skin contact with liquid during manufacture of wet-strength (polyamide) resins for paper | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |
| 9. | Inhalation of vapor and skin contact with liquid during textile fiber processing and textile surface coating | A,B,D | Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, respiratory protective devices) |

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