NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND SUPPORTING DOCUMENTATION FOR

*** ETHYLENE CHLOROHYDRIN ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for ETHYLENE CHLOROHYDRIN

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 ETHYLENE CHLOROHYDRIN.

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.

(a) Definitions.

(1) "Permissible exposure" means inhalation of ethylene chlorohydrin in concentrations not in excess of 5 parts per million (ppm) (16 milligrams per cubic meter, mg/cu.m.) averaged over an eight-hour work shift, as stated in $$ 1910.93, Table G-1.

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

(b) Exposure determination and measurement.

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

(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 ethylene chlorohydrin;

(ii) Any measurements of ethylene chlorohydrin taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethylene chlorohydrin; 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 ethylene chlorohydrin 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 ethylene chlorohydrin 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 ethylene chlorohydrin 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 ethylene chlorohydrin 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 ethylene chlorohydrin 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 ethylene chlorohydrin

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%, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
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 ethylene chlorohydrin above the permissible expsure as defined in paragraph (a) (1) of this section.

(2) Employee exposures to airborne concentrations of ethylene chlorohydrin 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: (i) 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 ethylene chlorohydrin.

(ii) In the design of open surface tank ventilation for the purposes of § 1910.94 (d), operations involving ethylene chlorohydrin shall be classified as A-2 at 70 degrees F.

(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

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of ethylene chlorohydrin 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.

TABLE 2 RESPIRATORY PROTECTION FOR ETHYLENE CHLOROHYDRIN

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
10 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 10 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. (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 face mask providing protection against organic vapors. 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.

(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 ethylene chlorohydrin.

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

(3) For the purpose of compliance with § 1910.157, ethylene chlorohydrin 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 ethylene chlorohydrin shall be Class I, Group D.

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

(6) Where a fan is located in ductwork and where ethylene chlorohydrin is present in the ductwork in concentrations greater than 12250 ppm (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 ethylene chlorohydrin presents a fire or explosion hazard.

(8) Ethylene chlorohydrin shall be stored so as not to come in contact with strong oxidizers and strong caustics.

(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 ethylene chlorohydrin. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

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

(3) Where there is any possibility of exposure of an employee's body to liquid ethylene chlorohydrin, 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 ethylene chlorohydrin be removed immediately and not reworn until the ethylene chlorohydrin 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 ethylene chlorhydrin contacting the eyes.

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

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

(2) Liquid ethylene chlorohydrin 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 ethylene chlorohydrin immediately wash or shower to remove any ethylene chlorohydrin from the skin.

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

(3) Employers shall ensure that employees who handle liquid ethylene chlorohydrin wash their hands thoroughly with water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which ethylene chlorohydrin is present shall keep a copy of this regulation with Appendices 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 ethylene chlorohydrin above the action level, or employees who may have skin or eye contact with liquid ethylene chlorohydrin, or employees who work where accidental release, spill, fire, or explosion of ethylene chlorohydrin may occur, shall annually:

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

(ii) Advise affected employees as to the signs and symptoms of exposure to ethylene chlorohydrin;

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

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

(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 ethylene chlorohydrin or airborne concentrations of ethylene chlorohydrin at or above the action level, without regard to the use of respirators, a medical examination which shall include as a minimum the following:

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

(ii) A profile of liver function.

(iii) 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.

(ii) A record of the results of liver function tests.

(iii) A record of the results of urinalysis.

(4) The employer shall make available to each employee, exposed to ethylene chlorohydrin in excess of the action level at 6 months from the date of the employee's first exposure for the first two years, 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) Tests of liver function (see paragraph (j)(2)(ii) of this section).

(iii) Urinalysis (see paragraph (j)(2)(iii) 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) A record of the results of liver function tests.

(iii) A record of the results of the urinalysis.

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

(i) A copy of this regulation with its Appendices A, B, and C;

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

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

(iv) The results of any employee's exposure measurement, if available;

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

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

(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 could be directly or indirectly aggravated by exposure to ethylene chlorohydrin or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.

(B) Any recommended limitations on the employee's exposure to ethylene chlorohydrin.

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

(ii) The written opinion shall not reveal medical information unrelated to exposure to ethylene chlorohydrin.

(8) No employee shall be exposed to ethylene chlorohydrin if such exposure could place the employee at increased risk of material impairment of his health. 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 ethylene chlorohydrin.

(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 ethylene chlorohydrin.

(ii) This record shall include:

(A) The date of measurement;

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

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

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

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

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

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

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

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

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

(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) This 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 ethylene chlorohydrin;
(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.
(l) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to ethylene chlorohydrin which is conducted pursuant to this section.
(2) When observation of measurement of employee exposure to ethylene chlorohydrin 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 ethylene chlorohydrin that are being performed at the place of exposure; and
(iii) Record the results obtained.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYLENE CHLOROHYDRIN

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.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR ETHYLENE CHLOROHYDRIN

I. SUBSTANCE IDENTIFICATION

A. Substance: Ethylene chlorohydrin

B. Permissible Exposure: 5 parts of ethylene chlorohydrin per million parts of air (ppm) or 16 milligrams of ethylene chlorohydrin per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless liquid with an ether-like odor.

II. HEALTH HAZARD DATA

A. Comments: It should be noted that on overexposure to ethylene chlorohydrin little margin of safety exists between early reversible symptoms and fatal intoxication.

B. Ways in Which the Chemical Affects Your Body: Ethylene chlorohydrin can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may be absorbed through the skin without causing irritation.

C. Effects of Overexposure:

1. Exposure to ethylene chlorohydrin vapor may cause irritation of the eyes, nose, throat and lungs, nausea, vomiting, dizziness, poor coordination, numbness, visual disturbance, liver or kidney damage (lower concentrations may cause serious effects without causing irritation). Breathing in higher concentrations produces headache, thirst, delirium, low blood pressure, collapse and unconsciousness. The urine may contain blood. Death may occur from lung or brain damage. Absorption through the skin can cause the above symptoms without skin irritation. Prolonged overexposure to ethylene chlorohydrin may cause your skin to become yellow and a change in frequency of urination or the amount of urine.

2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to ethylene chlorohydrin.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If ethylene chlorohydrin 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 ethylene chlorohydrin gets on your skin, immediately flush the contaminated skin with water. If ethylene chlorohydrin soaks through your clothing, remove the clothing immediately and flush the skin with water. Get medical attention immediately.

C. Breathing: If you or any other person breathes in large amounts of ethylene chlorohydrin, 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 immediately.

D. Swallowing: When ethylene chlorohydrin 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 ethylene chlorohydrin. 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 ethylene chlorohydrin while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent any possibility of skin contact with liquid ethylene chlorohydrin. Replace or repair impervious clothing that has developed leaks. Ethylene chlorohydrin attacks many forms of rubber.

C. Eye Protection: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) if there is any possibility of liquid ethylene chlorohydrin contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

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

B. Ethylene chlorohydrin must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong oxidizers and strong caustics.

C. Sources of ignition such as smoking and open flames are prohibited wherever ethylene chlorohydrin is handled, used or stored in manner that could create a potential fire or explosion hazard.

D. If your skin becomes contaminated with liquid ethylene chlorohydrin you must immediately wash or shower to remove any ethylene chlorohydrin from the skin.

E. You must immediately remove any non-impervious clothing that becomes contaminated with liquid ethylene chlorohydrin and this clothing must not be reworn until the ethylene chlorohydrin is removed from the clothing.

F. You must not eat or smoke in areas where ethylene chlorohydrin is handled, processed or stored.

G. If you handle liquid ethylene chlorohydrin, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

H. 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.

I. Ask your supervisor where ethylene chlorohydrin 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 ethylene chlorohydrin and to instruct you in the safe and correct use of protective equipment.

B. Your employer is required to determine whether you are being overexposed to ethylene chlorohydrin. You or your representative has the right to observe employee exposure measurements and to be informed of the results.

C. Your employer is required to release your exposure determination and medical records to your physician upon written request from your physician.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR ETHYLENE CHLOROHYDRIN

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYLENE CHLOROHYDRIN

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2-chloroethanol; 2-chloroethyl alcohol
2. Formula: CH_2ClCH_2OH
3. Molecular weight: 80.5

B. Physical Data

1. Boiling point (760 mm Hg): 130 C (266 F)
2. Specific gravity (water=1): 1.2
3. Vapor density (air=1 at boiling point of ethylene chlorohydrin): 2.8
4. Melting point: -62.6 C (-81 F)
5. Vapor pressure at 20 C (68 F): 5 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): miscible in all proportions
7. Evaporation rate (butyl acetate = 1): data not available
8. Appearance and odor: Colorless liquid with an ether like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 55 C (140 F) (closed cup)
2. Autoignition temperature: 425 C (797 F)
3. Flammable limits in air, % by volume: Lower: 4.9; Upper: 15.9
4. Extinguishing media: Dry chemical, carbon dioxide, alcohol foam
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: Ethylene chlorohydrin is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where ethylene chlorohydrin is used, handled or stored. Ethylene chlorohydrin vapors are heavier than air and may travel along the ground and be ignitied by sparks or open flames at locations remote from the site at which ethylene chlorohydrin is handled.
7. For purposes of complying with the requirements of 29 CFR 1910.106, ethylene chlorohydrin is classified as a Class III A combustible liquid. At 12,000 ppm, one-fourth of the lower flammable limit, ethylene chlorohydrin 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 ethylene chlorohydrin shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong caustics may cause formation of flammable ethylene gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving ethylene chlorohydrin.
4. Special precautions: Ethylene chlorohydrin will attack some forms of plastics, rubber and coatings. Special attention to the care and maintenance of personal protective equipment must be maintained.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If ethylene chlorohydrin 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 collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Ethylene chlorohydrin 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:
Ethylene chlorohydrin 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 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 8-hour sample or two (2) 4-hour samples. Several short term interval samples (up to 30 minutes) may also be used to determine average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of ethylene chlorohydrin to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring under this section should be essentially the same as described under paragraph (IV)(A). Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of ethylene chlorohydrin to plus or minus 25%.

C. Methods meeting these accuracy requirements are available from NIOSH.

D. 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 ethylene chlorohydrin in tightly closed containers in a cool, well-ventilated area.

B. Non-sparking tools must be used to open and close metal ethylene chlorohydrin containers. These containers must be effectively grounded and bonded prior to pouring.

C. Employers should advise employees of all areas and operations where exposure to ethylene chlorohydrin could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to ethylene chlorohydrin is likely to occur are: during its use as an intermediate in the preparation of dyes, pharmaceuticals, ethylene oxide, ethylene glycol, morpholine, cellosolve solvents, and acrylic and methacrylic esters; as a fumigant for seed potatoes; during dyeing operations and cleaning, degreasing and dewaxing operations; and during its production.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Ethylene chlorohydrin vapor is highly toxic to the liver, kidneys, brain and other organs. It is rapidly absorbed through the skin. A concentration of 250 ppm was fatal to rats in 4 hours, while 125 ppm was not lethal. A human fatality was reported following exposure to an estimated 300 ppm for 2 1/4 hours. In another fatal case, autopsy showed severe damage to the liver and brain. Several employees survived exposures averaging 18 ppm, but showed signs of circulatory shock with incoordination and repeated vomiting. There is little margin of safety between early reversible symptoms and fatal intoxication. Absorption by any route, including the skin, may lead to severe illness or death. Contact with vapor causes irritation of mucous membranes, nausea, vomiting, vertigo, incoordination, numbness, and visual disturbance. With higher concentrations, headache, severe thirst, delirium, low blood pressure, collapse, shock, and coma may result. Urine may contain albumin, casts, and red blood cells. Death results from pulmonary edema or from congestion and edema of brain. The cause of the toxic effect is probably the result of oxidation of the alcohol to chloracetic acid. The liquid instilled in rabbit eyes caused moderately severe injury, but in human eyes corneal burns have been observed to recover within 48 hours. Skin contact is particularly hazardous because the absence of signs of immediate irritation prevents any warning when the skin is wetted by the substance.

III. SIGNS AND SYMPTOMS

Irritation of mucous membranes; nausea and vomiting; vertigo, incoordination; numbness; visual disturbances; headache, severe thirst, delirium, low blood pressure, collapse, shock and coma.

IV. SPECIAL TESTS

Levels of urine chlorinated acidic acid may give indication of exposure.

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. Give artificial resuscitation if indicated. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Ethylene chlorohydrin is highly toxic and has poor warning properties. It is rapidly absorbed through inhalation and skin contact. Various organ systems may be affected. It is important that the physician becomes familiar with plant operating conditions in which exposure to ethylene chlorohydrin 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. Rubber gloves do not provide adequate protection from undiluted or from aqueous solutions.

B. PREPLACEMENT

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

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of respiratory system, liver, kidneys and central nervous system should be stressed. The skin should be examined for evidence of chronic disorders.

2. Liver function tests -- Ethylene chlorohydrin may cause liver damage. A profile of liver function shall be obtained by utilizing a medically acceptable array of biochemical tests.

3. 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 a semi-annual basis for the first two years and annually thereafter.

References

1. American Conference of Governmental Industrial Hygienists: "Ethylene Chlorohydrin," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 108-109.

2. Hygienic Guide Series: "Ethylene Chlorohydrin," American Industrial Hygiene Association Journal, 22:513-515, 1961.

3. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles C. Thomas, Illinois, 1974, pp. 266-267.

4. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1492-1496.

REFERENCES AND SOURCES
ETHYLENE CHLOROHYDRIN
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. 14.

(2) Open surface tank classification based on boiling point of 266 F and guidelines found in Ansi Z9,1-1971, "Practices for Ventilation and Operation of open surface tanks," p. 19.

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

Eye: Union Carbide Corporation, "Toxicology Studies - Ethylene Chlorohydrin;" Grant, "Toxicology of the Eye"

Skin: Union Carbide Corporation, "Toxicology Studies - Ethylene Chlorohydrin;" Patty, "Industrial Hygiene and Toxicology:" Sax, "Dangerous Properties of Industrial Materials"

Ingestion: Union Carbide Corporation, "Toxicology Studies - Ethylene Chlorohydrin;" Sax, "Dangerous Properties of Industrial Materials"

COMMENTS

Eye - Classification: 1
Output statement numbers: 9, 13
Exceptions: 6 replaced by 7a

According to the Union Carbide Guide "one tiny drop, as might be present in a fine spray, caused burns of the rabbit eye." Grant reports that "contact of the liquid with the eye experimentally in rabbits has caused moderately severe injury, graded 7 on a scale of 1 to 10, but in human(s) eye corneal burns have been known to recover promptly, usually in 48 hours." Given that Grant's latter statement does not prove conclusively that only transitory corneal injury occurs, the substance is given a hazard classification of 1. It is to be noted that Grant only states that burns in human eyes have been "known" to "promptly" heal. This only indicates that there is at least one case where permanent injury did not occur from contact.

Skin - Classification: 1 and 4
Output statement numbers: 1, 7a, 8a, 14g, 14i, 20a
Exceptions: None

The rabbit single skin penetration LD50 is 0.10 ml/kg, according to the Union Carbide Guide, which continues to say "this result suggests that the chemical penetrated the skin in harmful amounts." Union Carbide work also showed that "the undiluted chemical caused no reaction on the tender skin of the rabbit belly." Patty notes that in one documented death "percutaneous absorption was a significant factor." As a local irritant, Sax rates it moderately toxic; via acute skin absorption, it is highly toxic systemically. Its flash point is 131 F. Its vapor pressure at 20 C is only 5 mm Hg. It is firmly concluded that skin contact with this substance is extremely hazardous. It has virtually no local warning properties but can cause death of humans

in amounts which would wet only a small portion of the body.

Ingestion - Classification: 1
Output statement numbers: 19, 20a
Exceptions: None

The oral rat LD50 is 0.089 g/kg as reported in the Union Carbide. This figure is generally supported throughout the literature. Systemically, ethylene chlorohydrin is highly toxic in acute exposures, according to Sax.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

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

Union Carbide Corp., "Chemicals and Plastics Physical Properties," 1974 edition (UCC)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 5, p. 306 (K-O)

Sources of data items used:

I. A. 1. Synonyms: NFPA-325M
2. Formula: NFPA-325M
3. Molecular weight: UCC

B. 1. Boiling point: NFPA-325M
2. Specific gravity: NFPA-325M
3. Vapor density: NFPA-325M
4. Melting point: UCC
5. Vapor pressure: UCC
6. Solubility in water: NFPA-325M; UCC
7. Evaporation rate: data not available
8. Appearance and odor: K-O

II. A. 1. Flash point: calculated by ADL
2. Autoignition temperature: NFPA-325M
3. Flammable limits: NFPA-325M
4. Extinguishing media: NFPA-325M
5. Special fire fighting procedures: NFPA-325M
6. Unusual fire and explosion hazards: ADL

B. 1. Conditions contributing to instability: analogy
2. Incompatibilities: analogy
3. Hazardous decomposition products: analogy
4. Special precautions: analogy

III. A. Steps if released or spilled: analogy

C. Waste disposal method: analogy

V. Miscellaneous precautions: analogy

USE/EXPOSURE AND CONTROL DOCUMENT

Sources used in the preparation of this document include:

Bush, A. F., Abrams, H. K. and Brown, H. V., "Fatality and Illness Caused by Ethylene Chlorohydrin in an Agricultural Occupation," Journal of Industrial Hygiene and Toxicology, 31:352 - 358, 1949 (Bush)

Dierker, H. and Brown, P. G., "Study of a Fatal Case of Ethylene Chlorohydrin Poisoning," Journal of Industrial Hygiene and Toxicology, 26:277 - 279, 1944 (Dierker)

"Ethylene Chlorohydrin," American Conference of Government Industrial Hygienists, Hygienic Guide Series, December 1961 (Hygienic Guides)

Gafafer, W. M. - editor, "Occupational Diseases - A Guide to Their Recogni-

tion," U. S. Dept. of HEW, 1966 (OD)
Goldblatt, M. W. and Chiesman, W. E., "Toxic Effects of Ethylene Chlorohydrin," British Journal of Industrial Medicine, 1:207 - 213 (Goldblatt)
Jacobs, M., "The Analytical Chemistry of Industrial Solvents," Interscience Publishers, 1956 (Jacobs)
Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 1st edition, 1954 (Chem Tech)
Mellan, I., "Source Book of Industrial Solvents and Halogenated Hygdrocarbons," Reinhold, New York, 1957 (Mellan)
Patty, F. A., "Industrial Hygienic and Toxicology," Vol. II, Interscience Publishers, 1962 (Patty)

References for Specific Use/Exposure

1. Bush, Patty
2. Mellan, Jacobs
3. Goldblatt, Dierker, Patty
4. Goldblatt
5. Goldblatt, Browning
6. Mellan, Chem Tech
7. Dierker, Mellan
8. Patty, OD

References for Specific Control Methods

1. Bush, Hygienic Guides
2. Goldblatt, Hygienic Guides
3. Goldblatt, Hygienic Guides
4. Hygienic Guides, Goldblatt

Goldblatt and Hygienic Guides were the references used for the Specific Control Methods in numbers 6 - 8.

RESPIRATOR TABLE JUSTIFICATION

Browning reports several lethal doses for ethylene chlorohydrin which were determined by acute inhalation toxicity studies. Browning states that one investigator gave 32 ppm as an LC50 for a 4-hour exposure for rats. Another investigator determined that 7.5 ppm was lethal to rats in 1 hour, and 4 ppm was lethal following 2 exposures of 1 hour each. Browning notes that the "lethal dose differs somewhat in the hands of different observers."

Patty reports a LC50 of .11 mg/l (33 ppm) for rats for a 4-hour exposure; a LC17 of 1.2 mg/l (365 ppm) for mice for a 2-hour exposure; and a lethal concentration of 3 mg/l (912 ppm) for guinea pigs for a 1.8-hour exposure.

The NIOSH Toxic Substances List gives a LC50 of 290 mg/M3 (88 ppm) for rats; and a LC50 of 385 mg/M3 (117 ppm) for mice.

The AIHA Hygienic Guides state that 250 ppm was lethal to rats in 4 hours and that 125 ppm was not lethal. A concentration of 365 ppm for 2 hours was lethal to 1 out of 5 mice. An exposure to 305 ppm for one hour caused one human death.

Ethylene chlorohydrin is extremely toxic and readily absorbed through the skin. The NIOSH Toxic Substances List gives a LDL0 of 5000 mg/kg for humans when this substance is absorbed through the skin. This value, however, is just an estimate by the investigators of a dose which could possibly cause a human fatality, and it is not an actual, observed human fatal dose. The investigators determined a LD50 of .070 ml/Kg for ethylene chlorohydrin by absorption through the skin in the guinea pig, "where the anhydrous chemical is applied as a poultice"

to the skin of the animals. Most animals died within 24 hours. When skin contact was only for a period of 2 hours the LD50 of ethylene chlorohydrin in the guinea pig was determined to be .3 ml/kg. Spector also reports skin absorption LD50's of 85.6 mg/kg and 364 mg/kg for guinea pigs. The AIHA Hygienic Guides state that "contact with the vapor causes irritation of mucous membranes."

WARNING PROPERTIES: According to the AIHA Hygienic Guides, the warning properties of ethylene chlorohydrin are "poor and inadequate to prevent injury." Gas sorbent respiratory equipment is not permitted.

EYE IRRITATION: Ethylene chlorohydrin is an eye irritant, according to the Hygienic Guides.

IDLH: As Browning states, "The lethal dose differs somewhat in the hands of different observers." An LC50 of 290 mg/M3 (88 ppm) for rats is reported by the NIOSH Toxic Substances List. However, based on other data reported above, and a proposed ceiling TLV of 1 ppm, an IDLH of 10 ppm is used.

LFL: The lower flammable limit of ethylene chlorohydrin is 49,000 ppm.

PERMISSIBLE EXPOSURE: 5 ppm (16 mg/M3).

NOTE: This substance should not be promulgated until an LC50 can be determined with pure material. (Note the wide discrepencies in toxicological data listed above).

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYLENE CHLOROHYDRIN

USE/EXPOSURE AND CONTROL DOCUMENT
ETHYLENE CHLOROHYDRIN

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and contact with liquid during fumigation treatment of seed potatoes	A,D	General dilution ventilation; personal protective equipment (gloves, protective clothing, respiratory protective devices)
2.	Inhalation of vapor and contact with liquid during dyeing operations (color printing on textiles)	A,D	Process enclosure; local exhaust ventilation
3.	Inhalation of vapor and contact with liquid during cleaning, degreasing, and dewaxing operations	A,D	Material substitution; process enclosure; local exhaust ventilation
4.	Inhalation of vapor and contact with liquid during synthesis and handling of ethylene chlorohydrin	A,D	Process enclosure; local exhaust ventilation
5.	Inhalation of vapor and contact with liquid during organic synthesis (primarily ethylene glycol; also ethylene oxide, cellosolve solvents, acrylic and methacrylic esters)	A,D	Process enclosure; local exhaust ventilation
6.	Inhalation of vapor and contact with liquid during synthesis of dyes (including indigo)	A,D	Process enclosure; local exhaust ventilation
7.	Inhalation of vapor and contact with liquid during synthesis of pharmaceuticals (including procaine)	A,D	Process enclosure; local exhaust ventilation
8.	Inhalation of vapor and contact with liquid during resin processing	A,D	Process enclosure; local exhaust ventilation;
9.	Inhalation of vapor and	A,D	Process enclosure; local

contact with liquid during extraction processing (including pine lignin and oil of rose)	exhaust ventilation

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