NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** ETHYL CHLORIDE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for ETHYL CHLORIDE

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 ETHYL CHLORIDE.

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 ethyl chloride in concentrations not in excess of 1,000 parts per million (ppm) (2,600 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 ethyl chloride.

(b) Exposure determination and measurement.

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

(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 ethyl chloride;

(ii) Any measurements of ethyl chloride taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethyl chloride; 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 ethyl chloride 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 ethyl chloride 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 ethyl chloride 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 ethyl chloride 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 ethyl chloride 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 ethyl chloride 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 ethyl chloride above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of ethyl chloride 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 ethyl chloride.

(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 ethyl chloride 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 ETHYL CHLORIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
10,000 ppm or less	Any supplied-air respirator.
	Any self-contained breathing apparatus.
20,000 ppm or less	Any supplied air respirator with a full facepiece, helmet or hood.
	Any self-contained breathing apparatus with a full facepiece.
	A Type C supplied air respirator with a half-facepiece operated in pressure-demand or other positive pressure mode or continuous-flow mode.
Greater than 20,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
	A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure - demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	any gas mask providing protection against organic vapors.

	Any escape self-contained breathing apparatus.

(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 ethyl chloride.

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

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

(5) For the purpose of compliance with § 1910.106, liquid ethyl chloride is classified as a Class IA flammable liquid.

(6) Where a fan is located in ductwork and where ethyl chloride is present in the ductwork in concentrations greater than 9500 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 ethyl chloride is used, handled or stored.

(8) Ethyl chloride 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 repeated or prolonged skin contact with liquid ethyl chloride. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

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

(3) Employers shall ensure that clothing which becomes wet with liquid ethyl chloride be removed immediately and not reworn until the ethyl chloride has evaporated.

(4) 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 liquid ethyl chloride may contact the eyes.

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

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

(h) Sanitation. Reserved

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

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

(ii) Advise affected employees as to the signs and symptoms of exposure to ethyl chloride;

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

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

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

(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 obtain from each employee who is exposed, or will be exposed, to airborne concentrations of ethyl chloride at or above the action level, without regard to the use of respirators, information as to whether such employee has a history of any of the following medical conditions:

(i) Kidney disease
(ii) Liver disease
(iii) Chronic lung disease
(iv) Heart disease

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

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

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

(i) A copy of this regulation with Appendices A, B and C for ethyl chloride;

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

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

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

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

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

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

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

(B) Any recommended limitations upon the employee's exposure to ethyl chloride including limitations upon the use of 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 ethyl chloride.

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

(7) No employee shall be exposed to airborne concentrations of ethyl chloride in such a way as would put the employee at increased risk of material impairment of his health from such impairment. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency medical treatment for any employee injured through exposure to ethyl chloride.

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

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

(k) Recordkeeping. (1) Exposure determination.

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

(ii) 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 ethyl chloride.

(ii) This record shall include:

(A) The date of measurement;

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

(B) Any employee medical complaints relative to exposure to ethyl chloride;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(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 ethyl chloride which is conducted pursuant to this section.

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

(iii) Record the results obtained.

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 ETHYL CHLORIDE

I. SUBSTANCE IDENTIFICATION

A. Substance: Ethyl chloride

B. Permissible Exposure: 1000 parts of ethyl chloride per million parts of air (ppm) or 2600 milligrams of ethyl chloride per cubic meter of air (mg/cu m) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless liquid or gas with a pungent, ether-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Ethyl chloride can affect your body if you inhale it or if it comes in contact with

your eyes or skin or if you swallow it. In liquid form it may be absorbed through the skin.

B. Effects of Overexposure:

1. Short-Term Exposure: Ethyl chloride may cause drowsiness, unconsciousness, irregular heart beat and death. It may also cause irritation of the eyes and abdominal cramps. Spilled on the skin it may cause frostbite.
2. Long-Term Exposure: Ethyl chloride may cause liver and kidney damage.
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 ethyl chloride.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If liquid ethyl chloride 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 ethyl chloride gets on your skin, promptly wash the contaminated skin with water if the ethyl chloride has not already evaporated. If ethyl chloride soaks through your clothing, remove the clothing immediately and flush the skin with water. Do not use hot water for skin flushing. If irritation is present after washing, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of ethyl chloride, 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 ethyl chloride 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 ethyl chloride. 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 ethyl chloride 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 repeated or prolonged skin contact with ethyl chloride. Replace or repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) where eye contact to liquid ethyl chloride may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Ethyl chloride is a flammable liquid or gas and its vapors easily form explosive mixtures with air.

B. Ethyl chloride must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, and chemically active metals.

C. Sources of ignition such as smoking and open flames are prohibited wherever ethyl chloride 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 ethyl chloride, and containers must be bonded and grounded when pouring or transferring liquid ethyl chloride.

E. Clothing wet with liquid ethyl chloride can be easily ignited. You must immediately remove this clothing and it must not be reworn until the ethyl chloride has evaporated from the clothing.

F. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them.

G. Ask your supervisor where ethyl chloride 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 ethyl chloride 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 ethyl chloride. 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYL CHLORIDE

SUBSTANCE TECHNICAL GUIDELINES FOR ETHYL CHLORIDE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Chloroethane; monochloroethane; hydrochloric ether; muriatic ether
2. Formula: C_2H_5Cl
3. Molecular weight: 64.5

B. Physical Data

1. Boiling point (760 mm Hg): 12.2 C (54 F)
2. Specific gravity (water=1): 0.92
3. Vapor density (air=1 at boiling point of ethyl chloride): 2.2
4. Melting point: -139 C (-218 F)
5. Vapor pressure at 20 C (68 F): 1064 mm. Hg.
6. Solubility in water, % by weight at 20 C (68 F): 0.57
7. Evaporation rate (butyl acetate=1): much higher than 1
8. Appearance and odor: Colorless liquid or gas with a pungent, ether-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: -50 C (-58 F) (closed cup)
2. Autoignition temperature: 519 C (966 F)
3. Flammable limits in air, % by volume: Lower: 3.8; Upper: 15.4
4. Extinguishing media: Stop flow of gas. Use carbon dioxide, dry chemical or foam for small fires.
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Ethyl chloride is a flammable gas at room temperatures and pressure but it can exist as a liquid at temperatures below 12.2 C (54 F). It can easily form explosive mixtures with air. All ignition sources must be controlled. Ethyl chloride vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which ethyl chloride is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, liquid ethyl chloride is classified as a Class IA flammable liquid. At 9500 ppm, one-fourth of the lower flammable limit, ethyl chloride 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 ethyl chloride shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat

2. Incompatibilities: Contact with chemically active metals, such as sodium, potassium, calcium, powdered aluminum, zinc, magnesium may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene and carbon monoxide) may be released in a fire involving ethyl chloride.
4. Special precautions: Liquid ethyl chloride will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

A. If ethyl chloride is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources
2. Ventilate area of spill or leak
3. If in the liquid form, for small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to clear hood duct work, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Ethyl chloride may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
4. If in the gaseous form, stop flow of gas.

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

C. Waste disposal methods:
Ethyl chloride may be disposed of:
1. If in the liquid form, by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. If in the gaseous form, by burning 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 ethyl chloride 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 ethyl chloride 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 ethyl chloride in tightly closed containers in a cool, well-ventilated area.

B. High exposures to ethyl chloride can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal ethyl chloride containers. These containers must be effectively grounded and bonded prior to pouring of the liquid.

D. Do not use flames to detect leaks of ethyl chloride gas.

E. Employers should advise employees of all areas and operations where exposure to ethyl chloride could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to ethyl chloride is likely to occur are: during its use as an industrial refrigerant; as an aerosol propellant; as a local anesthetic in medicine; as a low-temperature solvent; as an intermediate in the preparation of lead tetraethyl and ethyl cellulose; in the synthesis of organic chemicals; in the manufacture of dyes, perfumes and drugs; and during its production.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

Ethyl chloride vapor is a narcotic. Guinea pigs died from 9 hour exposure to 40,000 ppm but survived 4 1/2 hour exposure; histopathological changes in the lungs, liver and kidneys were observed in animals in the latter group. Inhalation of 40,000 ppm by human subjects caused dizziness, eye irritation, and abdominal cramps, while inhalation of 3.36 volumes percent (33,600 ppm) caused a toxic effect after 30 seconds increasing within 5 minutes to noisy talkativeness followed by incoordination. At 2.5 volumes percent (25,000 ppm) there was incoordination, while 1.9 percent (19,000 ppm) caused weak analgesia after 12 minutes and 1.3 percent (13,000 ppm) caused slight symptoms of inebriation. Sudden and unforeseen fatalities from ethyl chloride anesthesia have been reported, probably due to respiratory or cardiac arrest. Chronic effects from industrial exposure have not been reported, although skin absorption is said to occur. In liquid form this substance may cause frostbite.

III. SIGNS AND SYMPTOMS

At high levels, may cause incoordination and inebriation; abdominal cramps; cardiac arrhythmias and cardiac arrest; signs and symtoms of liver and kidney damage.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin if splashed with liquid. Give artificial resuscitation if indicated. Recovery is usually rapid and complete. Caution should be exercised in using epinephrines or similar drugs.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of ethyl chloride are caused by its narcotic properties. It is possible that extremely high concentrations may cause cardiac arrhythmias and death. It is important that the physician becomes familiar with plant operating conditions in which exposure to ethyl chloride occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

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

1. Liver disease -- Ethyl chloride is known as a liver toxin in animals and justifies consideration before exposing persons with impaired liver function.

2. Kidney disease -- Ethyl chloride is known as a kidney toxin in animals and justifies special consideration before exposing persons with impaired renal function.

3. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethyl chloride might cause exacerbation of symptoms due to its irritant properties.

4. Cardiovascular disease -- In persons with impaired cardiovascular function, especially those with a history of cardiac arrythmias, the inhalation of ethyl chloride might cause exacerbation of disorders of the conduction mechanism due to its sensitizing effects on the myocardium.

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: "Ethyl Chloride," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 106.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1273-1275.

3. Hygienic Guide Series: "Ethyl Chloride," American Industrial Hygiene Association Journal, 24:531-533, 1963.

4. von Oettingen, W. F.: The Halogenated Aliphatic, Olefinic, Cyclic, Aromatic, Aliphatic-Aromatic Hydrocarbons Including The Halogenated Insecticides, Their Toxicity and Potential Dangers, U.S. Public Health Service Publication No. 414, U.S. Government Printing Office, Washington, D.C., 1955, pp. 128-134.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYL CHLORIDE

REFERENCES AND SOURCES
ETHYL CHLORIDE
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.

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

Eye: Sax, "Dangerous Properties of Industrial Materials"; Grant, "Toxicology of the Eye"

Skin: Manufacturing Chemists Association Chemical Safety Data Sheet, "Ethyl Chloride"; American Conference of Governmental Industrial Hygienists, "Documentation of Threshold Limit Values"; Kirk - Othmer, "Encyclopedia of Chemical Technology"; Dow Material Safety Data Sheet, "Ethyl Chloride"; Sax, "Dangerous Properties of Industrial Materials"; and Deichman and Gerarde, "Toxicology of Drugs and Chemicals"

Ingestion: Manufacturing Chemists Association Chemical Safety Data Sheet, "Ethyl Chloride"; Sax, "Dangerous Properties of Industrial Materials"

COMMENTS

Eye - Classification: 2
Output statement numbers: 10
Exceptions: None

Sax states "the liquid is harmful to the eyes and can cause some irritation." Grant reports work which showed "spraying the liquid on rabbit corneas has caused epithelial damage, not attributable to temperature lowering, but to solvent or chemical action."

Skin - Classification: 2
Output statement numbers: 2, 7b, 16i, 21
Exceptions: 16i and 20a deleted because of low boiling point and high vapor pressure; 21 modified

The MCA states that "in contact with the skin can act as a refrigerant, even at times producing frostbite . . . aside from this it acts only as a mild and temporary irritant to skin." It further states that some skin absorption is possible, although the probability of hazard through this route is termed "most remote." The Documentation of TLV's states that ethyl chloride is "readily absorbed" through the skin; Kirk - Othmer agrees. The boiling point of ethyl chloride is about 54 deg. F. Its closed cup flash-point is about -58 deg. F. Deichman and Gerarde suggest that "it should not be sprayed on broken skin. If absorbed it may cause liver injury, ventricular fibrillation, and CNS effects." Sax rates the local effect of an acute exposure as slight.

Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None

According to the MCA "the probability of swallowing is

most remote." Sax rates the local and systemic effects of an acute exposure as moderate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)
Manufacturing Chemists Association, Chemical Safety Sheet SD-50 (MCA)
Shell Chemical Co., Material Safety Data Sheet (Shell)
Dow Chemical USA, Material Safety Data Sheet (Dow)
Ethyl Corp., Material Safety Data Sheet (Ethyl)
Matheson Gas Data Book, 5th edition, p. 241

Sources of data items used:

I. A. 1. Synonyms: MCA; NFPA-325M
2. Formula: NFPA-325M
3. Molecular weight: Math
B. 1. Boiling point: Dow; NFPA-325M
2. Specific gravity: MCA, NFPA-325M
3. Vapor density: MCA; Dow; NFPA-325M
4. Melting point: MCA; Dow
5. Vapor pressure: Dow; Ethyl
6. Solubility in water: Ethyl; NFPA-325M
7. Evaporation rate: ADL
8. Appearance and odor: MCA; Shell; NFPA-49

II. A. 1. Flash point: MCA, NFPA-325M
2. Autoignition temperature: MCA, NFPA-325M
3. Flammable limits: NFPA-325M; Shell (MCA reports 3.6 - 12%)
4. Extinguishing media: Shell; Dow; Ethyl
5. Special fire fighting procedures: NFPA-49; 325M
6. Unusual fire and explosion hazards: Shell; NFPA-49
B. 1. Conditions contributing to instability: analogy
2. Incompatibilities: NFPA-49; anlogy
3. Hazardous decomposition products: Shell; Dow
4. Special precautions: analogy

III. A. Steps if released or spilled: MCA; Dow; Ethyl
C. Waste disposal method: MCA; Shell

V. Miscellaneous precautions: MCA; Ethyl

USE/EXPOSURE AND CONTROL DOCUMENT

References used for the preparation of this document include:

Browning, Ethel, "Toxicity and Metabolism of Industrial Solvents," Elsevier Publishing Co., 1965 (Browning)
Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California, 1962 (SRI)
Doolittle, Arthur K., "The Technology of Solvents and Plasticizers," John Wiley and Sons, 1954 (Doolittle)
Elkins, Hervey, "The Chemistry of Industrial Toxicology," John Wiley and Sons, 1959 (Elkins)
"Ethyl Chloride," Chemical Engineering, April 29, 1974, p. 144 (Chem Eng)
"Ethyl Chloride," Chemical Profile, April 1, 1974, Schnell Publishing Company (CP)
"Ethyl Chloride," Hygienic Guide Series, AIHA Journal, September - October 1963 (Hygienic Guide)
Faith, W. L., Keyes, D. B., and Clark, R. L., "Industrial Chemicals,"

John Wiley and Sons, 1965 (Faith)
Hamilton, A. and Hardy, H., "Industrial Toxicology," Publishing Sciences Group, Inc., 1974 (H & H)
International Labour Organization, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)
Jacobs, Morris, "The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents," Interscience Publishers, 1956 (Jacobs)
Kirk, R. E. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Encyclopedia Inc., 1st and 2nd edition, 1954 and 1972 (K-O)
"Occupational Diseases - A Guide to Their Recognition," U. S. Department of HEW, 1966 (OD)
Patty, Frank A., editior, "Industrial Hygiene and Toxicology," Interscience Publishers, Inc., 1967 (Patty)
Plunkett, E. R., "Handbook of Industrial Toxicology," Chemical Publishing Co., Inc., 1966 (Plunkett)

References for Specific Use/Exposure

1. H & H, SRI, CP, Hygienic Guide
2. K-O, Faith, SRI, OD
3. Elkins, Plunkett, Jacobs, Patty
4. Doolittle, Chem Eng, OD
5. Hygienic Guide, Plunkett, SRI
6. Browning, K-O, Plunkett, OD
7. Chem Eng, SRI, OD, K-O
8. K-O, SRI, Chem Eng, OD
9. Chem Eng, K-O
10. OD

References for Specific Control Methods

ILO, Plunkett and Hygienic Guide was the references used for the Specific Control Methods in numbers 1 - 10.

RESPIRATOR TABLE JUSTIFICATION

According to Patty, fire and explosion are the major hazards from ethyl chloride in industry, since "very little physiological difficulty has been encountered." Patty reports that in an acute study on the response of guinea pigs to ethyl chloride, some deaths were caused by exposures to 230,000 - 240,000 ppm for 5 - 10 minutes; 153,000 ppm for 30 - 40 minutes; and 40,000 ppm for 540 minutes.

Patty notes the effects observed in a study in which the narcotic concentrations for man were investigated. Two inhalations at a concentration of 40,000 ppm resulted in stupor, eye irritation, and abdominal cramps. After a 30-second exposure to 33,600 ppm, a rapid increase in toxic effects occurred. A concentration of 25,000 ppm resulted in a lack of coordination; 20,000 ppm in "dizziness and slight abdominal cramps;" 19,000 ppm in slight analgesia after 12 minutes; 13,000 ppm in slight symptoms of poisoning.

The Manufacturing Chemists' Association (MCA) states that, in industrial use, ethyl chloride presents very little health hazard. MCA also reports that concentrations of 20,000 ppm or greater can have an anesthetic effect when inhaled.

WARNING PROPERTIES: Ethyl chloride has a somewhat pungent, ether-like odor, but no quantitative data are available on the odor threshold. For the purposes of this standard, therefore,

ethyl chloride has been treated as a material with poor warning properties.

EYE IRRITATION: Ethyl chloride is not a known eye irritant. Grant reports that at 4% the gas has been noted to cause slight irritation of the eyes of human beings.

IDLH: The AIHA Hygienic Guides do not give an IDLH concentration. Based upon the human exposure data in which 20,000 ppm was reported to cause "dizziness and slight abdominal cramps" and 19,000 ppm was reported to cause weak analgesia after 12 minutes, an IDLH of 20,000 ppm is assumed for the purposes of this standard.

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

PERMISSIBLE EXPOSURE: 1000 ppm.

USE/EXPOSURE AND CONTROL DOCUMENT
ETHYL CHLORIDE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of gas and eye contact with vapor during production of tetraethyl lead	A,B	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (goggles)
2.	Inhalation of gas and eye contact with vapor during production of ethyl cellulose	A,B	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment (goggles)
3.	Inhalation of gas and eye contact with vapor during use as a local or general anesthetic	A,B	General dilution ventilation; personal protective equipment (gloves)
4.	Inhalation of gas, skin contact with liquid, and eye contact with vapor during use as a refrigeration compound	A,B	General dilution ventilation; personal protective equipment (goggles, gloves)
5.	Inhalation of gas, skin contact with liquid, and eye contact with vapor during use as a solvent for fats, oils, waxes, phosphorous, acetylene, and many resins	A,B	General dilution ventilation; process enclosure; personal protective equipment (goggles, gloves)
6.	Inhalation of gas and eye contact with vapor during synthesis of organic chemicals (including perchloroethane, esters, and Grignard reagents)	A,B	General dilution ventilation; process enclosure; personal protective equipment (goggles)
7.	Inhalation of gas and eye contact with vapor during manufacture of dyes	A,B	General dilution ventilation; process enclosure; personal protective equipment (goggles)
8.	Inhalation of gas and eye contact with vapor during the manufacture of certain drugs	A,B	General dilution ventilation; process enclosure; personal protective equipment (goggles)

9.	Inhalation of gas and eye contact with vapor during packaging and use of aerosols containing ethyl chloride as a propellant.	A,B	General dilution ventilation; process enclosure; personal protective equipment (goggles)
10.	Inhalation of gas and eye contact with vapor during manufacture of perfumes containing ethyl chloride	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (goggles)

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