

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** TRICHLOROETHYLENE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TRICHLOROETHYLENE

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 TRICHLOROETHYLENE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of trichloroethylene not in excess of 100 parts per million (ppm) averaged over an eight-hour work shift (time weighted average) and not in excess of 200 parts per million (ppm) at any time during an eight-hour work shift except that an exposure not in excess of 300 parts per million (ppm) at any aggregate of 5 minutes in any 2 hours shall be permitted as stated in § 1910.1000, Table Z-2.

(2) "Action level" means one half of the permissible exposure for trichloroethylene for an eight-hour work shift.

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

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

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

(ii) Any measurements of trichloroethylene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to trichloroethylene; 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 trichloroethylene 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 trichloroethylene 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 trichloroethylene 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 trichloroethylene 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.

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to trichloroethylene 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.

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(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to trichloroethylene 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 the time periods appropriate to the permissible exposure (See Appendix B (iv) of this section).

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

Table 1

Concentration	Required Accuracy
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 trichloroethylene above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of trichloroethylene 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 trichloroethylene.

(ii) In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving trichloroethylene shall be classified as B-1 at 70 degrees F.

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

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- (i) During the time period necessary to install or implement engineering or work practice controls; or
 - (ii) In work situations in which engineering and work practice controls are technically not feasible; or
 - (iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of trichloroethylene 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 TRICHLOROETHYLENE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION

Vapor Concentration	
500 ppm or less	A chemical cartridge respirator with organic vapor cartridge(s). ----- Any supplied-air respirator. ----- Any self-contained breathing apparatus.
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1000 ppm or less	A chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). ----- A gas mask with a chin-style or a front- or back-mounted organic vapor canister. ----- Any supplied-air respirator with a full facepiece, helmet or hood. ----- Any self-contained breathing apparatus with a full facepiece.
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Greater than 1000 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

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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 trichloroethylene.

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

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

(5) Spray finishing operations shall be performed in accordance with § 1910.94(c).

(6) Where a fan is located in ductwork and where trichloroethylene is present in the ductwork in concentrations greater than 26,000 ppm (approximately 25 percent 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 trichloroethylene presents a fire or explosion hazard.

(8) Trichloroethylene shall be stored so as not to come in contact with strong caustics or 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 trichloroethylene. 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 trichloroethylene is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of trichloroethylene from the clothing. If the clothing is to be laundered or

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otherwise cleaned to remove the trichloroethylene, the employer shall inform the person performing the operation of the hazardous properties of trichloroethylene.

(3) Employers shall ensure that non-impervious clothing which becomes contaminated with liquid trichloroethylene be removed promptly and not re-worn until the trichloroethylene is removed from the clothing.

(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 trichloroethylene may contact the eyes.

(g) Spills and disposal. In the event that liquid trichloroethylene is spilled the employer shall immediately provide available ventilation and then clean up the spill.

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

(i) Training and information. (1) Each employer who has a workplace in which trichloroethylene is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to trichloroethylene above the action level or employees who may have skin or eye contact with liquid trichloroethylene, or employees who work where a spill of trichloroethylene may occur, shall annually:

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

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

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

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

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

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

(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.

(4) The employer shall make available to each employee, exposed to trichloroethylene in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure in

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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).

(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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(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.

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(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 trichloroethylene.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to trichloroethylene 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.

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

(ii) The record shall include:

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

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

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

(D) Physician's written opinion; and

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

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

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

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

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

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

(2) When observation of measurement of employee exposure to trichloroethylene 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 trichloroethylene 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.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET
FOR TRICHLOROETHYLENE

I. SUBSTANCE IDENTIFICATION

- A. Substance: Trichloroethylene
- B. Permissible Exposure: 100 parts of trichloroethylene per million parts of air (ppm) averaged over an eight-hour work shift. Also, 200 ppm shall not be exceeded during an eight-hour work shift except that a peak of 300 ppm is permitted for 5 minutes in any 2 hours during the work shift.
- C. Appearance and Odor: Colorless liquid, unless dyed, with a sweet odor like chloroform.

II. HEALTH HAZARD DATA

- A. Ways in Which the Chemical Affects Your Body: Trichloroethylene can affect your body if you inhale it or if it comes in contact with your eyes or skin or if you swallow it.
- B. Effects of Overexposure:
 - 1. Short-Term Exposure: Trichloroethylene may cause nausea, vomiting, dizziness, numbness and tingling, drowsiness, unconsciousness, irregular heart beat, and death. If alcohol has been consumed it may make the symptoms of exposure to trichloroethylene worse, and may cause your skin to become flushed. Trichloroethylene vapor may also cause irritation of the eyes, nose and throat. If the liquid is swallowed it may cause diarrhea, visual problems. You may also experience the shakes, sleepiness, nausea and vomiting. If the liquid is splashed in the eye, it may cause an irritation.
 - 2. Long-Term Exposure: Repeated or prolonged contact with liquid trichloroethylene may cause irritation of the skin. Repeated contact with the vapor may cause addiction to this chemical.
 - 3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to trichloroethylene.

III. EMERGENCY FIRST AID PROCEDURES

- A. Eye Exposure: If trichloroethylene gets into your eyes, wash the eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.
- B. Skin Exposure: If trichloroethylene gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If trichloroethylene soaks through your clothing, remove the clothing promptly and wash the skin using soap or

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mild detergent. If irritation persists after washing, get medical attention.

- C. Breathing: If you or any other person breathes in large amounts of trichloroethylene move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.
- D. Swallowing: When trichloroethylene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the 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 trichloroethylene. 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 trichloroethylene 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 liquid trichloroethylene. Replace or repair impervious protective clothing that has developed leaks.
- C. Eye Protection: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) where liquid trichloroethylene may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Trichloroethylene vapors, at elevated temperatures, form explosive mixtures with air.
- B. Trichloroethylene must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks,

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flames, strong caustics, aluminum, and chemically active metals.

- C. Sources of ignition such as smoking and open flames are prohibited wherever trichloroethylene is handled, used or stored in a manner that could create a potential fire or explosion hazard.
- D. You must promptly remove any non-impervious clothing that becomes contaminated with liquid trichloroethylene and this clothing must not be reworn until the trichloroethylene is removed from the clothing.
- E. If your skin becomes wet with liquid trichloroethylene, you must promptly wash or shower with soap or mild detergent to remove the trichloroethylene from your skin.
- 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 trichloroethylene 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 trichloroethylene. In addition, your employer must instruct you in the safe use of trichloroethylene, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to trichloroethylene. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
FOR TRICHLOROETHYLENE

- I. PHYSICAL AND CHEMICAL DATA
- A. Substance Identification
1. Synonyms: Ethylene trichloride; triclene
 2. Formula: $\text{CHCl}=\text{CCl}_2$
 3. Molecular weight: 131.4
- B. Physical Data
1. Boiling point (760 mm Hg): 87 C (188 F)
 2. Specific gravity (water = 1): 1.46
 3. Vapor density (air = 1 at boiling point of trichloroethylene): 4.5
 4. Melting point: -86.4 C (-123 F)
 5. Vapor pressure at 20 C (68 F): 58 mm Hg
 6. Solubility in water, % by weight at 20 C (68 F): 0.1
 7. Evaporation rate (butyl acetate = 1): 6.2
 8. Appearance and odor: Colorless liquid, unless dyed, with a sweet odor, like chloroform
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
- A. Fire
1. Flash point: None in normal test method.
 2. Autoignition temperature: 410 C (770 F)
 3. Flammable limits in air, % by volume: (at elevated temperatures): Lower: 10.5; Upper: 41
 4. Extinguishing media: Foam, carbon dioxide, dry chemical
 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: Trichloroethylene vapors, at elevated temperatures, can form explosive mixtures with air. All ignition sources must be controlled where trichloroethylene is used, handled or stored in a manner that could create a potential fire or explosion hazard.
 7. Above 26,000 ppm, one fourth of the lower flammable limit, is one situation in which trichloroethylene 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 trichloroethylene shall be Class I Group D.
- B. Reactivity
1. Conditions contributing to instability: When exposed to light and air, trichloroethylene slowly decomposes and

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becomes acid. When this occurs in presence of aluminum, a violent decomposition reaction may occur.

2. Incompatibilities: Contact with strong caustic may cause formation of dichloroacetylene, a toxic and flammable gas. Batches of trichloroethylene that have become acidic react violently with aluminum, causing explosions and fires. Trichloroethylene will react with chemically active metals such as barium, lithium, sodium, magnesium, and titanium.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene and carbon monoxide) may be released in a fire involving trichloroethylene.
4. Special precautions: Liquid trichloroethylene will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If trichloroethylene is spilled or leaked, the following steps should be taken:
 1. Ventilate area of spill or leak.
 2. Collect for reclamation or absorb in vermiculite, dry sand, earth or a similar material.
- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: Trichloroethylene may be disposed of by absorbing in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES

- A. Exposure Above the Action Level:
 1. Eight hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average eight-hour exposure may be determined from a single sample or two (2) four-hour samples. Short term samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).
 2. Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of trichloroethylene in the employee's breathing zone. A minimum of three measurements should be taken on one work shift and the highest of all

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measurements taken is an estimate of the employee's exposure.

3. Peak Above Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentration of trichloroethylene. Each measurement should consist of a 5-minute sample or series of consecutive samples totaling five (5) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

4. Monitoring Techniques: The sampling and analyses under this section may be performed by instruments such as: detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of trichloroethy to plus or minus 35%.

B. Exposure Above the Permissible Exposure: The monitoring and measurements under this section should be essentially the same described under paragraph (IV)(A). When sampling for peak exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence may be placed in the judgement that the employee has or has not, in fact, been exposed in excess of the permissible limit. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of trichloroethylene to plus or minus 25%.

C. Methods: Methods meeting the above accuracy requirements are available from NIOSH.

D. Qualified Persons: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Store trichloroethylene in tightly closed containers in a cool, well ventilated area.

B. Trichloroethylene should be inspected periodically to detect presence of acid. Material that is acid must not be used in presence of aluminum.

C. High exposures to trichloroethylene can occur when transferring the liquid from one container to another.

D. Employers should advise employees of all areas and operations where exposure to trichloroethylene could occur.

VI. COMMON OPERATIONS

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Common operations in which exposure to trichloroethylene is likely to occur are: during its production and its use as a solvent for vapor degreasing of metals, dry cleaning, extraction of vegetable material and cold cleaning; as a heat transfer fluid, anesthetic and fumigant; during its use in the manufacture of textiles and rubber; and during its use in surface coatings, cleaning and polishing preparations and adhesives.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Trichloroethylene vapor is a narcotic. In dogs, cardiac sensitization to epinephrine occurred at concentrations of 5000 to 10,000 ppm. Other dogs exposed repeatedly to 500 to 750 ppm became lethargic, vomited, lost weight, and showed liver dysfunction. Human exposure to trichloroethylene has produced several fatal cardiac arrhythmias. Fatal intoxication of workers has been reported in a well documented case, where the exposure was to levels estimated at 1700 to 3300 ppm for 10 minutes. Injury to lungs, liver or kidneys has been reported infrequently. Trigeminal nerve paralysis has been reported. Overexposure produces headache, vertigo, visual disturbances, tremors, somnolence, nausea, and vomiting. A group of female workers exposed to approximately 270 ppm complained of flushed skin, weakness, vomiting, and abdominal cramps; minor cardiac arrhythmias were observed in some. Slight impairment of psychophysiological efficiency has been described from tests on human experimental subjects at vapor concentrations of 100 ppm, but these observations were not confirmed in other studies. Voluntary habituation to trichloroethylene vapor occurs in industry. A peculiar dermal response resulting from the ingestion of alcoholic beverages after repeated exposure to trichloroethylene has been described: This consists of cutaneous vasodilatation of the face, neck, shoulders and back. Breath analysis for trichloroethylene has provided a more accurate index of exposure than has measurement of metabolites (trichloroethanol and trichloroacetic acid) in the urine. A few drops of the liquid in the eye will result in transient pain and conjunctival irritation. It also has a defatting action on the skin, and dermatitis may result from repeated contact with the liquid or with high concentrations of the vapor. Trichloroethylene has been reported to induce hepatic carcinoma in mice.

III. SIGNS AND SYMPTOMS

Headache, vertigo, visual disturbances, tremors, somnolence, nausea and vomiting; eye irritation; dermatitis. Cardiac arrhythmias have been reported.

IV. SPECIAL TESTS

- Breath analysis for trichloroethylene.

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

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artificial resuscitation if indicated. Recovery is usually rapid and complete. The use of epinephrine or similar vasopressor drugs is contraindicated.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of trichloroethylene are caused by its narcotic properties. Alcohol ingestion potentiates the effects. Cardiac arrhythmias may occur. It is important that the physician become familiar with plant operating conditions in which exposure to trichloroethylene occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

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

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

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis.

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REFERENCES AND SOURCES
TRICHLOROETHYLENE
1910.93

- (d) Compliance - Open surface tank classification based on relative evaporation rate of 1.25 hours (from Doolittle)
- (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. 20.
- (f) Personal Protective Equipment, and, (h) Sanitation
 - Eye: Grant "Toxicology of the Eye;" MCA, "Trichloroethylene"
 - Skin: MCA, "Trichloroethylene;" Gleason, "Clinical Toxicology of Commercial Products;" Sax, "Dangerous Properties of Industrial Materials;" AIHA Hygienic Guide Series, "Trichloroethylene;" Schwartz, "Occupational Diseases of the Skin;" Stewart et al, "Absorption of Carbon Tetrachloride, Trichloroethylene,

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USE/EXPOSURE AND CONTROL DOCUMENT
TRICHLOROETHYLENE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid and vapor during cleaning and other maintenance of degreasing equipment	A,B	General dilution ventilation; personal protective equipment (respiratory protective devices, goggles, boots, gloves, safety harness)
2.	Inhalation of vapor and skin contact with liquid and vapor during metal degreasing operation (cold cleaning and vapor degreasing in metal working, electronics manufacture, and in aerospace industries and precision tools and instruments manufacture)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons)
3.	Inhalation of vapor and skin contact with liquid and vapor during application of surface coatings containing solvent and surface coating remover (including paint, varnish, and tar remover; paint and lacquer thinners; industrial paints especially those containing tar or pitch; inks)	A,B	Process enclosure; local exhaust ventilation; personal protective equipment (gloves, aprons, goggles, respiratory protective devices)
4.	Inhalation of vapor and skin contact with liquid and vapor during textile manufacture and processing (including scouring and cleaning of raw wool, cotton, cotton/synthetic fiber blends; spot cleaning of yarns, piece-goods to remove oils, waxes, fats; dissolving of basting threads; textile dyeing)	A,B	Process enclosure; local exhaust ventilation
5.	Inhalation of vapor and skin contact with liquid and vapor during cleaning	A,B	Process enclosure; local exhaust ventilation

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and degreasing operations (including drycleaning of fabrics and furs; cleaning of glass items such as optical lenses, dishes, films, molded articles)

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| 6. | Inhalation of vapor and skin contact with liquid or vapor during extraction and purification processing (including vegetable and mineral oils such as olive, corn, linseed, soybean, cocoa butter; mineral and vegetable waxes; caffeine and nicotine; purification of sulfur and phosphorous from gas; dewaxing of lubrication oils and mineral oils; pharmaceuticals; spice oleoresins; fat-free glue from tannery residues and wax and paraffin from refuse) | A,B | Process enclosure; local exhaust ventilation |
| 7. | Inhalation of vapor and contact with liquid and vapor during manufacture of rubber products (especially synthetic rubbers such as neoprene) | A,B | Process enclosure; local exhaust ventilation |
| 8. | Inhalation of vapor and skin contact with liquid and vapor during fumigation operations (including seeds and grains and other uses as a disinfectant and insecticide) | A,B | Local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves) |
| 9. | Inhalation of vapor and skin contact with liquid and vapor during synthesis and handling of substance | A,B | Process enclosure; local exhaust ventilation |
| 10. | Inhalation of vapor and skin contact with liquid | A,B | Process enclosure; local exhaust ventilation; per- |

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and vapor during manufacture of surface coatings containing solvent and surface coating removers (including paint, varnish, and tar remover; paint and lacquer thinners; industrial paints especially those containing tar or pitch; inks)

sonal protective equipment (gloves, aprons, goggles, respiratory protective devices)

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| 11. | Inhalation of vapor and skin contact with liquid and vapor during manufacture of cleaning and polishing preparations (including soaps, household cleaning compounds, rug cleaner, spot remover, solvent-type metal polish, shoe and stove polish, suede polish, auto body cleaner/polish) | A,B | Process enclosure; local exhaust ventilation |
| 12. | Inhalation of vapor and skin contact with liquid and vapor during manufacture and use of adhesives containing solvent (including rubber cement and in boot and shoe industry) | A,B | Process enclosure; local exhaust ventilation |
| 13. | Inhalation of vapor and skin contact with liquid during preparation and handling of anesthetic and analgesic preparations | A,B | Process enclosure; local exhaust ventilation |
| 14. | Inhalation of vapor and skin contact with liquid and vapor during synthesis of other chemicals (including 1,1,2,2-tetrachloroethyl sulfenyl chloride, pentachloroethane, perchloroethylene, titanium dioxide | A,B | Process enclosure; local exhaust ventilation |

A -- Inhalation

B -- Skin and eye contact resulting in localized irritation

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- C -- Ingestion
- D -- Skin contact resulting in
absorption and subsequent
systemic poisoning

----- JES2 JOB STATISTICS -----

1,249 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

