

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND  
SUPPORTING DOCUMENTATION FOR

\*\*\* METHYL CHLOROFORM \*\*\*

NIOSH/OSHA Draft Technical Standard  
and Supporting Documentation for METHYL CHLOROFORM

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 METHYL CHLOROFORM.

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 methyl chloroform not in excess of 350 parts per million (ppm) (1,900 milligrams per cubic meter, mg/m<sup>3</sup>) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

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

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

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

(i) Any information, observations, or calculation which may indicate employee exposure to methyl chloroform;

(ii) Any measurements of methyl chloroform taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to methyl chloroform; 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 methyl chloroform 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 methyl chloroform 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 methyl chloroform 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 methyl chloroform 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 methyl chloroform 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 methyl chloroform below the action level, the employer may terminate measurement for the employee.

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

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

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

Table 1

| Concentration                                                  | Required Accuracy |
|----------------------------------------------------------------|-------------------|
| Above permissible exposure                                     | $\pm 25\%$        |
| At or below permissible exposure<br>and above the action level | $\pm 35\%$        |
| At or below the action level                                   | $\pm 50\%$        |

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

(2) Employee exposures to airborne concentrations of methyl chloroform 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 methyl chloroform.

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

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

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

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- (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 methyl chloroform to at or below the permissible exposure; or
  - (iv) For operations which require entry into tanks or closed vessels; or
  - (v) In emergencies.
- (5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR METHYL CHLOROFORM

| CONDITION                                                             | PERMISSIBLE RESPIRATORY PROTECTION                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vapor Concentration                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 500 ppm or less                                                       | <p>A chemical cartridge respirator with organic vapor cartridge(s).</p> <p>Any supplied air respirator.</p> <p>Any self-contained breathing apparatus.</p>                                                                                                                                                                                                                                                         |
| 1000 ppm or less                                                      | <p>A chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).</p> <p>A gas mask with a chin-style or a front- or back-mounted organic vapor canister.</p> <p>Any supplied-air respirator with a full facepiece, helmet or hood.</p> <p>Any self-contained breathing apparatus with a full facepiece.</p>                                                                                |
| Greater than 1000 ppm or entry and escape from unknown concentrations | <p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode</p> <p>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</p> |

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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 methyl chloroform.

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

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

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

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

(7) Where a fan is located in ductwork and where methyl chloroform is present in the ductwork in concentrations greater than 17,000 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.

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

(9) Methyl chloroform shall be stored so as not to come in contact with strong oxidizers, strong caustics, and 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 methyl chloroform. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

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(2) Employers shall ensure that non-impervious clothing which becomes wet with liquid methyl chloroform be removed promptly and not reworn until the methyl chloroform is removed from the clothing.

(3) 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 methyl chloroform may contact the eyes.

(g) Spills and disposal. In the event that liquid methyl chloroform 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 methyl chloroform promptly wash or shower to remove any methyl chloroform from the skin.

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

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

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

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

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

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

(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 liquid methyl chloroform or airborne concentrations of methyl chloroform 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) Liver disease

(ii) Skin disease

(iii) Cardiovascular 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

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(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 methyl chloroform which are listed in Appendix A which the employee suspects are caused by exposure to methyl chloroform.

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

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

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

(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; 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 methyl chloroform or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to methyl chloroform 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 methyl chloroform.

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

(7) No employee shall be exposed to liquid methyl chloroform or airborne concentrations of methyl chloroform 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.

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

(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.

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(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 methyl chloroform.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to methyl chloroform 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) The 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 methyl chloroform;

(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.

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(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 methyl chloroform which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to methyl chloroform 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 methyl chloroform 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 METHYL CHLOROFORM

I. SUBSTANCE IDENTIFICATION

- A. Substance: Methyl chloroform
- B. Permissible Exposure: 350 parts of methyl chloroform per million parts of air (ppm) (1900 milligrams of methyl chloroform per cubic meter of air, mg/cu m) averaged over an eight-hour shift.
- C. Appearance and Odor: Colorless liquid with a mild odor like chloroform.

II. HEALTH HAZARD DATA

- A. Ways in Which the Chemical Affects Your Body: Methyl chloroform can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it.
- B. Effects of Overexposure:
  - 1. Short-Term Exposure: Exposure to methyl chloroform vapor may cause headache, dizziness, drowsiness, unconsciousness, irregular heart beat, and death. Methyl chloroform liquid splashes in the eyes may cause irritation.
  - 2. Long-Term Exposure: Prolonged or repeated skin contact with liquid methyl chloroform may cause irritation of the skin.
  - 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 methyl chloroform.

III. EMERGENCY FIRST AID PROCEDURES

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

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- D. Swallowing: When methyl chloroform 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 methyl chloroform. 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 methyl chloroform 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 methyl chloroform. 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 eye contact to liquid methyl chloroform may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

- A. Methyl chloroform vapors, at elevated temperatures, can form explosive mixtures with air.
- B. Methyl chloroform must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong caustics, strong oxidizers, and chemically active metals.
- C. Sources of ignition such as smoking and open flames are prohibited wherever methyl chloroform is handled, used or stored in a manner that could create a potential fire or explosion hazard.

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- D. If your skin becomes wet with liquid methyl chloroform, you must promptly wash or shower with soap or mild detergent and water to remove the methyl chloroform from your skin.
- E. You must promptly remove any non-impervious clothing that becomes wet with liquid methyl chloroform and this clothing must not be reworn until the methyl chloroform is removed 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 methyl chloroform 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 methyl chloroform. In addition, your employer must instruct you in the safe use of methyl chloroform, emergency procedures, and the correct use of protective equipment.
- B. Your employer is required to determine whether you are being exposed to methyl chloroform. 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 METHYL CHLOROFORM

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 1,1,1-trichloroethane; 1,1,1-trichloroethane, stabilized
2. Formula: CH3CCl3
3. Molecular weight: 133.4

B. Physical Data

1. Boiling point (760 mm Hg): 74 C (165 F)
2. Specific gravity (water = 1): 1.33
3. Vapor density (air = 1 at boiling point of methyl chloroform): 4.55
4. Melting point: -37.9 C (-36.4 F)
5. Vapor pressure at 20 C (68 F): 100 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.07
7. Evaporation rate (butyl acetate = 1): 12.8
8. Appearance and odor: Colorless liquid with a mild odor, like chloroform

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: None in normal test method.
2. Autoignition temperature: 500 C (932 F)
3. Flammable limits in air, % by volume: (at elevated temperature and pressure): Lower: 7; Upper: 16
4. Extinguishing media: Foam, dry chemical, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Methyl chloroform vapors, at elevated temperatures, can form explosive mixtures with air. All ignition sources must be controlled where methyl chloroform is used, handled or stored in a manner that could create a potential fire or explosion hazard.
7. Above 17,000 ppm, one-fourth of the lower flammable limit, is one situation in which methyl chloroform is considered to be a potential fire and explosion hazard.
8. For purposes of compliance with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electric Code for methyl chloroform shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: Heat.

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2. Incompatibilities: Contact with strong caustics, strong oxidizers, and chemically active metals such as aluminum and magnesium powders, or sodium and potassium 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 methyl chloroform.
4. Special precautions: Liquid methyl chloroform will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. If methyl chloroform 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: Methyl chloroform 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: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single eight-hour sample or two (2) 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84. Portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes with subsequent chemical analyses. The method of measurement must determine the concentration of methyl chloroform to plus or minus 35%.
- B. Exposure Above the Permissible Exposure: The monitoring and measurements under this section should be essentially the same as described under paragraph (IV)(A). Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of methyl chloroform 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

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competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

- A. Store methyl chloroform in tightly closed containers in a cool, well-ventilated area.
- B. Methyl chloroform must be inspected periodically to detect presence of acid. Methyl chloroform that contains acid must not be used in presence of aluminum.
- C. High exposures to methyl chloroform may occur when transferring the liquid from one container to another.
- D. Employers should advise employees of all areas and operations where exposure to methyl chloroform could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to methyl chloroform is likely to occur are: during its production and its use as a solvent for vapor degreasing, cold cleaning, ultrasonic cleaning, coatings, adhesives, cleaners for office equipment; as a coolant in cutting oils; in aerosol formulations; in the organic synthesis of vinylidene chloride; and in dyeing and dry cleaning operations.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Methyl chloroform vapor is a narcotic. Repeated exposure of animals to concentrations of 1000 to 10,000 ppm caused liver and lung changes in some species. In dogs, cardiac sensitization to epinephrine occurred at concentrations of 5000 to 10,000 ppm. A number of human fatalities related to industrial exposure in closed spaces have been reported. A five-minute exposure to 5000 ppm can be expected to produce marked incoordination and anesthesia. Prolonged exposure at this concentration may cause coma and death. Exposure to concentrations in excess of 1000 ppm for 15 minutes, or 2000 ppm for 5 minutes, can be expected to produce a disturbance of equilibrium in the majority of adults. Above 1700 ppm minor disturbances of equilibrium have been observed, with complaints of headache and lassitude. In controlled human exposures to 500 ppm no effects other than slight, transient eye irritation were noted; at 1000 ppm and above, mild eye irritation was experienced by all subjects and some became dizzy. Following exposure, most of the compound is eliminated unchanged via the lungs, chiefly within 48 hours. When placed into the rabbit eye, the liquid caused conjunctival irritation but no corneal damage. Dermatitis may result from repeated skin contact with the liquid.

III. SIGNS AND SYMPTOMS

Headache, lassitude; signs of central nervous system depression; disturbances of equilibrium; eye irritation; dermatitis from prolonged or repeated contact with the liquid. Possible cardiac arrhythmias.

IV. SPECIAL TESTS

Breath analysis for methyl chloroform; if present, it is an indication that exposure has occurred.

V. TREATMENT

Remove from exposure. Flush eyes with water and wash skin with soap and water. If swallowed and the person is conscious, induce vomiting. Give artificial resuscitation if indicated. Recovery is usually rapid and complete. The use of epinephrine or similar vasopressor drugs is contraindicated and may be dangerous.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

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Most reported effects of methyl chloroform are caused by its narcotic properties. Cardiac arrhythmias have been reported. It is important that the physician become familiar with plant operating conditions in which exposure to methyl chloroform 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 methyl chloroform exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Skin disease -- Methyl chloroform can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.
2. Liver disease -- Methyl chloroform causes liver changes in animals at high concentrations and justifies consideration before exposing persons with impaired liver function.
3. Cardiovascular disease -- In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the inhalation of methyl chloroform 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: "Methyl Chloroform (1,1,1-Trichloroethane)," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, pp. 161-162.
2. Hygienic Guide Series: "1,1,1-Trichloroethane (Methyl Chloroform)," American Industrial Hygiene Association Journal, 22:509-511, 1961.
3. "1,1,1-Trichloroethane: Emergency Exposure Limits," American Industrial Hygiene Association Journal, 25:585-586, 1964.

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4. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1287-1290.

5. Reinhardt, C. F., et al: "Epinephrine-Induced Cardiac Arrhythmia Potential of Some Common Industrial Solvents," Journal of Occupational Medicine, 15:953-955, 1973.

6. Grant, W. Morton: Toxicology of the Eye (2d ed.), Charles Thomas, Illinois, 1974, p. 1034.

7. Stewart, R.D.: "Methyl Chloroform Intoxication," Journal of the American Medical Association, 215:1789-1792, March 15, 1971.

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REFERENCES AND SOURCES  
METHYL CHLOROFORM

1910.93

- (d) Compliance - Open surface tank classification based on boiling point and guidelines in ANSI Z9.1.
- (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 Science, 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, Chemical Safety Data Sheet, "1,1,1-Trichloroethane;" Browning, "Toxicity and Metabolism of Industrial Solvents;" Ethyl Corporation Technical Data
  - Skin: MCA, Chemical Safety Data Sheet, "1,1,1-Trichloroethane;" Browning, "Toxicity and Metabolism of Industrial Solvents;" Patty, "Industrial Hygiene and Toxicology;" Sax, "Dangerous Properties of Industrial Materials"
  - Ingestion: MCA, Chemical Safety Data Sheet; Ethyl Corporation Technical Data; Patty, "Industrial Hygiene and Toxicology;" Browning, "Toxicity and Metabolism of Industrial Solvents;" Sax, Dangerous Properties of Industrial Materials"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

According to Grant "testing by drop application to rabbit eyes caused conjunctival irritation but no corneal damage; by splash or spray in the eyes its injurious effect has been superficial and transient." MCA states "undiluted 1,1,1-trichloroethane (methyl chloroform) spattered in eyes produces slight irritation which usually clears within hours; no serious injury would be expected, but appreciable discomfort may be experienced." Browning states that the effect of liquid exposure to the eyes is "mild conjunctivitis." Ethyl Corporation states that 4 of 6 rabbits tested showed moderate redness of conjunctival tissues and 2 of 6 showed slight inflammation of the iris; testing was performed according to Technical Hazardous Substances Labeling Act Specifications. All effects were reversible.

Skin - Classification: 2

Output statement numbers: 2, 16g, 16i

Exceptions: 7 and 20 deleted because of volatility  
MCA states "even repeated prolonged skin exposure is not likely to cause more than slight irritation; prolonged and frequent daily contact can defat tissues and may cause dermatitis." Browning reports irritation due to its defatting action when contact is repeated. Skin absorption is suggested in Browning as 15.8 g/kg applied under a cuff to rabbits killed less than half of the treatment group.

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Patty reports that, in a similar application, 3.9 g/kg was survived by all animals. Sax lists it as a slight local irritant in chronic and acute exposures and systemically through skin absorption in acute exposures. According to the Ethyl Corporation literature, "typical skin contact may result in slight irritation, prolonged or repeated contact can cause dermatitis." The substance cannot be ignited at any temperature up to its boiling point in a normal flashpoint test. Its vapor pressure at 20 C is 100 mm Hg.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

According to MCA, "swallowing amounts that might be splashed in ordinary handling presents no problem." Ethyl Corporation concurs. Browning reports an oral rat LD of 10.3 - 12.3 g/kg. Work cited by Patty determined the oral LD50 for male rats to be 12.3 g/kg and 10.3 g/kg for female rats. Sax lists it as a slightly hazardous substance locally in acute exposures and systemically in chronic exposures. It is concluded that the substance does not present an ingestion hazard, not only because of its low toxicity but also because of its relatively high volatility.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Manufacturing Chemists Association, Chemical Safety Data Sheet  
SD-90 (MCA)

Ethyl Corp., Technical Bulletin and Material Safety Data Sheet (Ethyl)

Dow Chemical USA, Material Safety Data Sheet (Dow)

Hooker Chemical Corp., Material Safety Data Sheet (Hook)

Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 5,  
p. 154 (K-O)

Sources of data items used:

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

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2. Incompatibilities: MCA; ADL
3. Hazardous decomposition products: MCA; Dow; Ethyl
4. Special precautions: Ethyl; Hook
- III. A. Steps if released or spilled: Ethyl
- C. Waste disposal method: MCA; Ethyl; Dow; Hook
- V. Miscellaneous precautions: Ethyl; ADL

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References used in the preparation of this document include:

- "About Face for Mace " National Safety News, 98, 66 - 68, 1968 (NIOSH Technical Information Service NIOSH 10181)
- Browning, E., "Toxicity and Metabolism of Industrial Solvents," Elsevier, 1965 (Browning)
- "Chemical Abstracts," 78, 79 (1973), 80 (1974), Chemical Abstracts Service (CA)
- "Chemical Engineering," 6/24/74, p. 149 (Chem Eng)
- "Chemical Engineering Prog." 69 (10), 86 - 8 (1973) (Chem Eng Prog)
- Considine, D. M., "Chemical and Process Technology Encyclopedia," McGraw Hill, 1974 (Considine)
- Elkins, H. B., "Chemistry of Industrial Toxicology," Wiley, 2nd edition, 1959 (Elkins)
- Hamilton, A. and Hardy, H. L., "Industrial Toxicology," Publishing Sciences Group, Inc., 3rd edition, 1974 (H/H)
- Hatfield, T. R. and Maykoski, R. T., "A Fatal Methyl Chloroform (Trichloroethane) Poisoning," Arch. Environ. Health, 20 (2), 279 - 81 1970 (NIOSH Technical Information Service NIOSH 31)
- Hawley, G. G., "The Condensed Chemical Dictionary," 8th edition, Van Nostrand - Reinhold, 1971 (Hawley)
- McKarns, J. S., Hill, F. N., and Bolton, P. R., "Monostyrene Vapor Concentrations from a Plastic Concrete," Am. Ind. Hyg. Assoc. J., 28, 414 - 17, 1967 (NIOSH Technical Information Service NIOSH 15444)
- Mellan, I., "Handbook of Solvents," Vol. II, Reinhold, 1957 (Mellan)
- "Methyl Chloroform," American Conference of Government Industrial Hygienists, Hygienic Guide Series, 1961 (Guide)
- "Methyl Chloroform," Dow Chem. Co. Material Safety Data Sheet (Dow MSDS)
- "Methyl Chloroform," Ethyl Corp. Material Safety Data Sheet (Ethyl MSDS)
- "Methyl Chloroform," Ethyl Corp. Technical Bulletin, "Chlorinated Solvents" (Ethyl-Chlorinated Solvents)
- "Methyl Chloroform," Ethyl Corp. Technical Bulletin, "General Cleaning with Multipurpose Grade 1,1,1-Trichloroethane" (Ethyl-Gen'l Cleaning)
- "Methyl Chloroform," Ethyl Corp. Technical Bulletin, "Toxicity and Handling Characteristics of Multipurpose Grade 1,1,1-Trichloroethane" (Ethyl-Toxicity and Handling)
- "Methyl Chloroform," Ethyl Corp. Technical Bulletin, "Vapor Degreasing with Chlorinated Solvents" (Ethyl-Vapor degreasing)
- "Methyl Chloroform," Ethyl Corp. Technical Bulletin, "The Variety of Applications for Multipurpose Grade 1,1,1-Trichloroethane" (Ethyl - Applications)
- "Methyl Chloroform," Hooker Chem. Corp. Bulletin (Hooker)
- "Methyl Chloroform," Hazard Process Index, Hazard Entry No. 193, NIOSH HSM-99-73-62 (HPI)
- "Methyl Chloroform," Mass. Dept. Labor and Industries, Division of Occupational Hygiene, Chemical Data Sheet No. 29 (Mass #29)

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"Methyl Chloroform," Penna. Dept. Environ. Resources, Division of Occupational Health, Hygienic Information Guide No. 90 (Penna #90)

Patty, F. A., "Industrial Hygiene and Toxicology," Vol. II, Interscience, 1962 (Patty)

"Polyurethanes - Hazards and Control," Michigan's Occupational Health, 16, 2 - 7, 1970 (NIOSH Technical Information Service NIOSH 13637)

Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)

Stewart, R. D., "The Toxicology of Methyl Chloroform," Journal of Occupational Medicine, 5, 159 - 62, 1963 (Stewart)

Valle-Riestra, J. F., "Food Processing with Chlorinated Solvents," Food Technology, 28 (2), 25 - 32 (1974) (Valle-Riestra)

References for Specific Use/Exposure

1. Chem Eng, Chem Eng Prog, Mellan, HPI, Considine, Guide, Mass #29, Patty, Elkins, Stewart, Hooker, Hawley, Ethyl-Cl Solvents, Ethyl-Applications, Ethyl-Gen'l Cleaning, SRI, H/H, NIOSH 31, NIOSH 15444, CA

2. Chem Eng Prog, HPI, H/H, Considine, Ethyl-Vapor Degreasing, Ethyl - Gen'l Cleaning, SRI, CA

3. SRI, Considine, Ethyl-Gen'l Cleaning, CA

4. Considine, HPI, Chem Eng, SRI

5. HPI, SRI, CA

6. Chem Eng, Chem Eng. Prog, Hooker, Hawley, H/H, HPI, NIOSH 10181, Considine, Ethyl-Cl Solvents, SRI, CA

7. Stewart, Patty, Guide, Chem Eng, HPI, NIOSH 13637, Browning, Mellan, Considine, SRI, Ethyl-Cl Solvents, CA

8. Guide, Chem Eng, HPI, Considine, SRI, CA

9. HPI, Considine, SRI, CA

10. Patty, H/H, Chem Eng, SRI, Ethyl-Cl Solvents, CA

References for Specific Control Methods

Penna #90, Guide, Mass #29, Patty, Hooker MSDS, Stewart, MCA, H/H, Elkins, Dow MSDS, Valle-Riestra, Ethyl MSDS, Ethyl-Toxicity and Handling

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RESPIRATOR TABLE DOCUMENTATION

Substance: Methyl chloroform

D. O. L. Standard: 350 ppm

WARNING PROPERTIES:

Odor Threshold: The AIHA Hygienic Guides state that the odor threshold of methyl chloroform may range from 20 - 100 ppm. Both Staub and Summer give 400 ppm as the odor threshold, however.

Eye Irritation Level: The Hygienic Guides state that "in controlled human exposures to 500 ppm no effects other than slight, transient eye irritation were noted, but at 1000 ppm and above, mild eye irritation was experienced by all subjects."

Evaluation of Warning Properties: Since the odor threshold of methyl chloroform is near or below the permissible exposure limit and since eye irritation occurs at a concentration only 2 times greater than the permissible exposure limit, methyl chloroform is treated as a material with adequate warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 1000 ppm

Basis for IDLH Value: This IDLH is based upon the statement in the Manufacturing Chemists' Association Safety Data Sheet SD90 which states that "Humans exposed to 900-1000 ppm experience prompt, thorough minimal impairment of coordination. Above 1700 ppm obvious disturbances of equilibrium in humans has been observed.

Deichman and Gerarde state that the earliest symptoms of a single vapor exposure are lightheadedness and lassitude. The earliest sign of intoxication is an impaired Romberg test. In humans an abnormal Romberg test is usually observed shortly after exposures to 900-1700 ppm. Since data is not available to indicate at what concentrations above 1000 ppm a persons equilibrium would be affected enough to impede escape, 1000 ppm is used as an IDLH.

The Hygienic Guides state that humans exposed to concentrations of 1000 ppm methyl chloroform exhibit "beginning anesthetic effects including incoordination." Browning states that several human subjects exposed to 920 ppm for periods ranging from 5 to 45 minutes "showed a slight loss of coordination and equilibrium." The Hygienic Guides suggest an IDLH of 30,000 ppm methyl chloroform but this concentration would be expected to be lethal within 5 to 6 minutes and, therefore, would not permit escape within 30 minutes.

Other Toxicological Information: According to Patty, the principal effect of exposure to high concentrations of methyl chloroform is CNS depression. Also, "it has little capacity to produce organic injury from either single or repeated exposure," Patty states.

The AIHA Hygienic Guides report that the CNS depression caused by exposures to high levels of methyl chloroform may lead to respiratory failure. In addition, the Hygienic Guides report that animal experiments have indicated that "this material can induce ventricular arrhythmia similar to that produced by other chlorinated solvents. Animals exposed repeatedly to high

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concentrations exhibited some reversible changes in liver histology, but they were not the severe effects associated with carbon tetrachloride."

The Hygienic Guides state that humans exposed to concentrations of 800 to 1000 ppm methyl chloroform exhibit "beginning anesthetic effects, including incoordination." At concentrations of 2000 ppm and greater, these effects occur rapidly. An exposure to a concentration of 30,000 ppm for 5 - 6 minutes may be lethal to humans.

Patty states that there was "no significant response" among humans exposed to 1000 ppm methyl chloroform for periods up to 70 minutes. "Definite disturbances of equilibrium" was noted among human subjects exposed to 2000 ppm, however.

Deichman and Gerarde also report that "brief vapor exposures above 1700 ppm produce disturbances of equilibrium." These authors note that 4 deaths have resulted from exposures to extremely high concentrations of methyl chloroform. Each fatal exposure occurred from the individual entering an unventilated tank.

Browning reports that among human subjects exposed to concentrations of 506 - 1900 ppm for periods ranging from 5 to 45 minutes, three of the individuals exposed to 920 ppm "showed a slight loss of coordination and equilibrium." Those exposed to 1900 ppm for 5 minutes exhibited obvious signs of intoxication.

LFL: 70,000 ppm

VAPOR PRESSURE: 100 mm Hg at 20 deg. C.  
125 mm Hg at 25 deg. C.

SATURATED CONCENTRATION AT: 20 deg. C.: Approximately 131,600 ppm  
25 deg. C.: Approximately 164,500 ppm

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USE/EXPOSURE AND CONTROL DOCUMENT  
METHYL CHLOROFORM

| Use/Exposure                                                                                                                                                                                                                                                                                                                                                                                                                     | Principal Route<br>of Entry | Currently Used<br>Control Methods                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Inhalation of vapor and skin contact with liquid during use as solvent in cold cleaning of metals and plastics by wiping, dipping, slushing, or spraying for removal of grease, oil, wax, tar, and adhesives (used for electric motors and generators, machinery, office equipment, appliances, production molds and equipment, gas cylinders, electronic components, parts for automotive, aircraft, or railroad industries) | A,B                         | General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 2. Inhalation of vapor and skin contact with liquid during use as solvent in vapor degreasing (Inhibited 1,1,1-trichloroethane is used as a replacement for trichloroethylene. It may contain nitromethane, N-methylpyrrole, 1,4-dioxane, butylene oxide, 1,3-dioxolane, or sec-butyl alcohols.)                                                                                                                                 | A,B                         | General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 3. Inhalation of vapor and skin contact with liquid during use as an ultrasonic cleaning solvent (used for manufacture of electronic components, missile components, high-vacuum equipment, precision instruments, and numerous other parts requiring ultra-cleanliness)                                                                                                                                                         | A,B                         | General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 4. Inhalation of vapor and                                                                                                                                                                                                                                                                                                                                                                                                       | A,B                         | Local exhaust ventilation;                                                                                                               |

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skin contact with liquid during manufacture and distribution of methyl chloroform and during maintenance of storage containers

personal protective equipment (protective clothing, respiratory protective devices)

- |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |                                                                                                                                 |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------|
| 5. | Inhalation of vapor and skin contact with liquid during use for organic synthesis (production of vinylidene chloride for polymer manufacture, addition to olefins, alkylation of aromatics)                                                                                                                                                                                                                                                          | A,B | Process enclosure; local exhaust ventilation                                                                                    |
| 6. | Inhalation of vapor and skin contact with liquid during use in manufacture of aerosols as a vapor pressure depressant and primary solvent and carrier (used in spot cleaners, adhesives, insecticides, shoe polishes, stain repellants, hair sprays, Mace for police and security work)                                                                                                                                                              | A,B | Process enclosure; local exhaust ventilation                                                                                    |
| 7. | Inhalation of vapor and skin contact with liquid during use as solvent and carrier (in adhesive formulations as resin solvent; as laboratory solvent; in shoe polishes, printing inks, insecticides; for thin-film application of silicones, water and stain repellants, epoxy resins, graphite, waxes, lubricants, and other protective coatings; for extraction of asphalts; in food extractions; in waste water treatment; in polymer technology) | A,B | Process enclosure; local exhaust ventilation                                                                                    |
| 8. | Inhalation of vapor and skin contact with liquid during use as a coolant and lubricant alone or in cutting oil composi-                                                                                                                                                                                                                                                                                                                              | A,B | General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, respiratory protective |

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tions for use on various  
metals

devices)

- |     |                                                                                                                                                                                                        |     |                                                                                                                                          |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------------------------------------------------------------------|
| 9.  | Inhalation of vapor and skin contact with liquid during miscellaneous uses (printed circuit board development, production of liquid Drano, in photographic film processing, for wig and hair cleaning) | A,B | General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |
| 10. | Inhalation of vapor and skin contact with liquid during use for dyeing and dry cleaning of fabrics and yarns and for processing and finishing of textiles                                              | A,B | General dilution ventilation; local exhaust ventilation; personal protective equipment (gloves, goggles, respiratory protective devices) |

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