

Occupational Health Guideline for Methyl Chloroform

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_2Cl_2
- Synonyms: 1,1,1-trichloroethane; 1,1,1-trichloroethane, stabilized
- Appearance and odor: Colorless liquid with a mild odor, like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for methyl chloroform is 350 parts of methyl chloroform per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 1910 milligrams of methyl chloroform per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 350 ppm ($1910 \text{ mg}/\text{m}^3$) averaged over a 15-minute period. The NIOSH Criteria Document for 1,1,1-Trichloroethane should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Methyl chloroform can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• 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 splashed 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. Reproductive abnormalities have been noted in studies of animals exposed to high concentrations of methyl chloroform.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to methyl chloroform.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to methyl chloroform at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the employee at increased risk, and to establish a baseline for future health monitoring. Examination of the skin, liver, and cardiovascular system should be stressed. The physician should be made aware of any adverse reproductive effects in workers exposed to methyl chloroform.

—Skin disease: Methyl chloroform can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: At high concentrations, methyl chloroform causes liver changes in animals, which justifies consideration of the possible consequences before exposing persons with impaired liver function.

—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.

—Medical warning: Workers should be provided with information advising them of studies in which congenital abnormalities were found following exposure of animals to high concentrations of methyl chloro-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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form. The physician should be made aware of any reproductive abnormalities in workers.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• **Summary of 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 5-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 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.

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 133.4
2. Boiling point (760 mm Hg): 74 C (165 F)
3. Specific gravity (water = 1): 1.33
4. Vapor density (air = 1 at boiling point of methyl chloroform): 4.55
5. Melting point: -38 C (-36 F)
6. Vapor pressure at 20 C (68 F): 100 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.07
8. Evaporation rate (butyl acetate = 1): 12.8

• **Reactivity**

1. Conditions contributing to instability: Heat.
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.

• **Flammability**

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. Extinguishant: Foam, dry chemical, carbon dioxide

• **Warning properties**

1. Odor Threshold: The AIHA *Hygienic Guide* states that the odor threshold of methyl chloroform may range from 20 to 100 ppm. Both May and Summer give 400 ppm as the odor threshold, however.

2. Eye Irritation Level: The *Hygienic Guide* states 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."

3. 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 twice the permissible exposure limit, methyl chloroform is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-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).

• **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of methyl chloroform. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure methyl chloroform may be used. An analytical method for methyl chloroform is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to 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.

• Non-impervious clothing which becomes wet with liquid methyl chloroform should be removed promptly and not reworn until the methyl chloroform is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid methyl chloroform may contact the eyes.

SANITATION

• Skin that becomes wet with liquid methyl chloroform should be promptly washed or showered to remove any methyl chloroform.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to methyl chloroform may occur and control methods which may be effective in each case:

Operation

Use as solvent in cold cleaning of metals, and plastics; in vapor degreasing; in ultrasonic cleaning; in dyeing and cleaning of fabrics and yarns

Use in organic synthesis in polymer manufacture; as primary and carrier solvent in spot cleaners, adhesives, shoe polishes, stain repellants, hair sprays, Mace, insecticides, resins, inks, lubricants, protective coatings, asphalt extraction, and waste water treatment; use in aerosol manufacture as pressure depressant

Use as coolant and lubricant in cutting oils on metals; use during printed circuit boards production; liquid Drano production and photographic film processing

Controls

General dilution ventilation; local exhaust ventilation; personal protective equipment

Process enclosure; local exhaust ventilation

General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If methyl chloroform gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If methyl chloroform gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If methyl chloroform soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a 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.

- **Swallowing**

When methyl chloroform has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

- **Rescue**

Move the 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. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

- 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.

- Waste disposal method:

Methyl chloroform may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR METHYL CHLOROFORM

Condition	Minimum Respiratory Protection* Required Above 350 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an 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.
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 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.

*Only NIOSH-approved or MSHA-approved equipment should be used.

