Occupational Health Guideline for Chloropicrin

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: CCl_3NO_2
- Synonyms: Nitrotrichloromethane; trichloronitromethane; nitrochloroform
- Appearance and odor: Colorless, oily liquid with a sharp, penetrating odor that causes tears.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chloropicrin is 0.1 part of chloropicrin per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 0.7 milligram of chloropicrin per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Chloropicrin 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: Chloropicrin causes eye irritation and tearing. It also causes cough, nausea, and vomiting, and severe irritation of the skin. Breathing chloropicrin vapors may also cause delayed severe breathing difficulties and which may cause death.

2. Long-term Exposure: Overexposure to chloropicrin may cause increased susceptibility to future overexposure.

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 chloropicrin.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to chloropicrin 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 exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system should be stressed. The skin should be examined for evidence of chronic disorders.

—FVC and FEV (1 sec): Chloropicrin is a severe respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure.

—14" x 17" chest roentgenogram: Chloropicrin may cause respiratory impairment. Persons with pre-existing pulmonary disease may be at increased risk.

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

- **Summary of toxicology**

Chloropicrin vapor is a severe irritant of the eyes, skin, and respiratory tract. A lethal exposure for humans is stated to be 119 ppm for 30 minutes, with death usually resulting from pulmonary edema; particular injury occurs in the medium and small bronchi. In addition to pulmonary irritation, human exposure results in lacrimation, cough, nausea, vomiting, and skin irritation; individuals injured by inhalation of chloropicrin vapor are said to be more susceptible to subsequent exposures. A concentration of 15 ppm could not be tolerated longer than 1 minute, even by persons acclimated to chloropicrin; exposure to 4 ppm for a few seconds is temporarily disabling, due to the irritant effects. Concentrations of 0.3 to 0.37 ppm resulted in painful eye irritation in 3 to 30 seconds. Chloropicrin is a severe skin irritant.

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 164.4
  2. Boiling point (760 mm Hg): 112 C (234 F)
  3. Specific gravity (water = 1): 1.635
  4. Vapor density (air = 1 at boiling point of chloropicrin): 5.7
  5. Melting point: −64 C (−83 F)
  6. Vapor pressure at 20 C (68 F): 20 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): 0.18
  8. Evaporation rate (butyl acetate = 1): Data not available
- **Reactivity**
  1. Conditions contributing to instability: High temperatures or severe shock, particularly when involving containers of greater than 30 gallons capacity.
  2. Incompatibilities: Contact with strong oxidizers may cause fires or explosions.
  3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen, phosgene, nitrosyl chloride, chlorine, and carbon monoxide) may be released when chloropicrin decomposes.
  4. Special precautions: Liquid chloropicrin will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Not combustible, but with strong initiation, heated material under confinement will detonate.
  2. Fires involving chloropicrin should be fought from an explosion-resistant location.
- **Warning properties**
  1. Odor Threshold: Stern reports an odor threshold of 0.0073 mg/l (1.1 ppm)
  2. Eye Irritation Level: The *Documentation of TLV's* states that "according to Flury and Zernik, chloropicrin in concentrations of from 0.3 to 0.37 ppm resulted in painful irritation to the eyes in 3 to 30 seconds." Patty, however, reports that 1.3 ppm is the lowest irritant concentration, but that 0.3 to 3.7 ppm for 3 to 30 seconds causes "closing of the eyelids according to individual sensitivity."
  3. Evaluation of Warning Properties: Through its irritant effects on the eyes, chloropicrin can be detected within three times the permissible exposure limit, according to the *Documentation of TLV's*. For the purposes of this guideline, therefore, it is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

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).

- **Method**

At the time of publication of this guideline, no measurement method for chloropicrin had been published by NIOSH.

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 any possibility of skin contact with liquid chloropicrin.
- Clothing contaminated with chloropicrin should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chloropicrin from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chloropicrin, the person performing the operation should be informed of chloropicrin's hazardous properties.
- Where there is any possibility of exposure of an employee's body to liquid chloropicrin, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with chloropicrin should be removed immediately and not reworn until the chloropicrin is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid chloropicrin contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid chloropicrin, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with chloropicrin should be immediately washed or showered with soap or mild detergent and water to remove any chloropicrin.
- Eating and smoking should not be permitted in areas where liquid chloropicrin is handled, processed, or stored.
- Employees who handle liquid chloropicrin should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as a soil fumigant, disinfectant, and sterilizer for control of fungi, nematodes, and other injurious organisms; liberation as a fumigant for stored grains, cereals, and fruits	Process enclosure; general dilution ventilation; personal protective equipment
Use as a rodenticide and insecticide for rats and insects	Process enclosure; general dilution ventilation; personal protective equipment
Use as a chemical intermediate in organic synthesis in dyes and as an oxidizing agent	Process enclosure; general dilution ventilation; personal protective equipment
Use as a warning agent in illuminating gas; use as a lacrimator, and as a nauseant in chemical warfare	General dilution ventilation; personal protective equipment
Use as a chemical sterilant without high temperature	General dilution ventilation; process enclosure; 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 liquid chloropicrin or high concentrations of chloropicrin vapor get into the eyes, wash 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.

- **Skin Exposure**

If liquid chloropicrin gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If liquid chloropicrin soaks through the clothing, remove the clothing immediately 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 chloropicrin, 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 liquid chloropicrin has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **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 liquid chloropicrin 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:

Chloropicrin may be disposed of by absorbing in vermiculite, dry sand, earth, or a similar material and disposing in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR CHLOROPICRIN

Condition	Minimum Respiratory Protection* Required Above 0.1 ppm
Vapor Concentration	
4 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 4 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 with a full facepiece providing protection against organic vapors.
	Any escape self-contained breathing apparatus with a full facepiece.

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

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of chloropicrin; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 4 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.