

Occupational Health Guideline for Chloroacetaldehyde

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: ClCH_2CHO
- Synonyms: 2-Chloroethanal; chloroacetaldehyde (40% aqueous)
- Appearance and odor: Colorless liquid with a very sharp, irritating odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chloroacetaldehyde is a ceiling level of 1 part of chloroacetaldehyde per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 3 milligrams of chloroacetaldehyde per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Chloroacetaldehyde can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed.

• Effects of overexposure

Chloroacetaldehyde causes skin burns, irritation of the throat, nose, and lungs, and serious irritation of the eyes.

• 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 chloroacetaldehyde.

• Recommended medical surveillance

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

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from chloroacetaldehyde exposure.

—Eye disease: Chloroacetaldehyde is a potent eye irritant and may cause tissue damage. Those with pre-existing eye problems may be at increased risk from exposure.

—Skin disease: Chloroacetaldehyde is a skin irritant and possibly a skin sensitizer. Those with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of chloroacetaldehyde might cause exacerbation of symptoms due to its irritant and potentially sensitizing properties.

—Kidney disease: Although chloroacetaldehyde is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

—Liver disease: Although chloroacetaldehyde is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Overexposure to chloroacetaldehyde produces corrosive destruction and degradation of lipids and membrane structures, causing intense irritation and edema of the eyes, mucous membranes, respiratory tract, and skin. Prolonged exposure to the liquid causes tissue destruction, chemical burns, and residual scarring. Some permanent damage to the eye may occur. Chloroacetaldehyde and its metabolite, chloroacetic acid, are

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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excreted by the kidneys. The possibility of skin and respiratory sensitization should be considered.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 78.5
2. Boiling point (760 mm Hg): 85 C (185 F)
3. Specific gravity (water = 1): 1.19 for 40% aqueous solution
4. Vapor density (air = 1 at boiling point of chloroacetaldehyde): 2.7 for 40% aqueous solution
5. Melting point: -16.3 C (3 F) for 40% aqueous solution
6. Vapor pressure at 45 C (113 F): 100 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions

8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with oxidizing materials and acids may cause fires or explosions. The compound reacts with water to form a hydrate with the evolution of some heat.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving chloroacetaldehyde.
4. Special precautions: Chloroacetaldehyde forms a water-insoluble polymer in storage, especially in the presence of small amounts of acid.

• Flammability

1. Flash point: 88 C (190 F) (closed cup) for 40% aqueous solution
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Carbon dioxide, dry chemical, or alcohol foam

• Warning properties

1. Odor Threshold: By analogy to crotonaldehyde and acetaldehyde, both of which the *Handbook of Organic Industrial Solvents* states have odor thresholds less than 1 ppm, the odor threshold of chloroacetaldehyde is assumed to be less than 1 ppm.
2. Irritation Levels: The *Documentation of TLV's* states that "chloroacetaldehyde presents a serious hazard from inhalation of its vapor, which is irritating to the eyes, nose, and throat . . . This aldehyde is somewhat more irritating than formaldehyde."

According to Grant, formaldehyde causes "definite irritation of the eyes and lacrimation . . . at a concentration of 20 ppm in air. Even at concentrations from 0.5 to 0.005 ppm a sensation of eye irritation is detectable, and it (formaldehyde) can be sensed as low as 0.01 ppm by some people."

The *Documentation of TLV's*, in addition, states that a "threshold limit of 1 ppm (chloroacetaldehyde) is recommended to prevent irritative effects. Analogy with

other aldehydes and practical experience suggest that the TLV will not prevent all complaints of irritation, and it should be used only with caution in continuous, repeated exposure situations."

3. Evaluation of Warning Properties: By analogy to other aldehydes, it is assumed that chloroacetaldehyde can be detected at the permissible exposure through its odor and irritant effects. For the purposes of this guideline, therefore, chloroacetaldehyde is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of chloroacetaldehyde. 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

An analytical method for chloroacetaldehyde is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1).

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 chloroacetaldehyde at or above a concentration of 0.1%.

- 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 solutions containing chloroacetaldehyde below a concentration of 0.1%.

- Clothing contaminated with chloroacetaldehyde should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chloroacetaldehyde from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chloroacetaldehyde, the person performing the operation should be informed of chloroacetaldehyde's hazardous properties.

- Where there is any possibility of exposure of an employee's body to solutions containing in excess of 0.1% chloroacetaldehyde, 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 chloroacetaldehyde should be removed immediately and not reworn until the chloroacetaldehyde 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 chloroacetaldehyde contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to liquid chloroacetaldehyde, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with chloroacetaldehyde should be immediately washed or showered to remove any chloroacetaldehyde.

- Employees who handle liquid chloroacetaldehyde 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 chloroacetaldehyde may occur and control methods which may be effective in each case:

Operation	Controls
Use during manufacture of 2-aminothiazole	Process enclosure; general dilution ventilation; personal protective equipment (with barrier creams)
Liberation during use in diethylacetal in acid media during chemical synthesis, such as p-aminothiazole	Process enclosure; general dilution ventilation; personal protective equipment
Use during control of algae, bacteria, and fungi in water	General dilution ventilation; personal protective equipment (with barrier creams)
Use as a spinning solution of poly B-alanine	General dilution ventilation; personal protective equipment (with barrier creams)
Liberation from intermediate steps in organic synthesis	Local exhaust ventilation
Use during debarking operations	Local exhaust ventilation; personal protective equipment
Use of diethylacetal in an acid media during chemical synthesis such as p-aminothiazole	Process enclosure; general dilution ventilation; personal protective equipment (with barrier creams)

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 chloroacetaldehyde gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible.

• Skin Exposure

If chloroacetaldehyde gets on the skin, immediately flush the contaminated skin with water. If chloroacetaldehyde soaks through the clothing, remove the clothing immediately and flush the skin with water. When there are chemical burns or evidence of skin irritation, get medical attention.

• Breathing

If a person breathes in large amounts of chloroacetaldehyde, 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 chloroacetaldehyde 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 chloroacetaldehyde is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

- Waste disposal methods:

Chloroacetaldehyde may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber equipped with an effluent gas cleaning device.

REFERENCES

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RESPIRATORY PROTECTION FOR CHLOROACETALDEHYDE

Condition	Minimum Respiratory Protection* Required Above 1 ppm
Vapor Concentration	
50 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.
250 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 250 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.

