

# Occupational Health Guideline for Acetic Acid

## 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:  $\text{CH}_3\text{COOH}$
- Synonyms: Glacial acetic acid; methane carboxylic acid; ethanoic acid; vinegar acid
- Appearance and odor: Colorless liquid or solid with a strong vinegar-like odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for acetic acid is 10 parts of acetic acid per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 25 milligrams of acetic acid per cubic meter of air ( $\text{mg}/\text{m}^3$ ).

## HEALTH HAZARD INFORMATION

- Routes of exposure  
Acetic acid 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:* Acetic acid vapors cause irritation of the eyes, nose, throat, and lungs. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Delayed breathing difficulties can occur. Contact with concentrated acetic acid may cause severe damage to the skin. Contact with concentrated acetic acid may very rapidly cause severe eye damage which may be followed by loss of sight. Swallowing concentrated acetic acid may cause severe injury or death.

2. *Long-term Exposure:* Repeated or prolonged exposure to acetic acid may cause a darkening or irritation of the skin, erosion of exposed front teeth, and chronic inflammation of the nose, throat, and bronchial tubes.

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 acetic acid.

- Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to acetic acid 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 acetic acid exposure.

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

—Skin disease: Acetic acid is a primary skin irritant. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

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

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

- Summary of toxicology

Acetic acid vapor is a severe irritant of the eyes, mucous membranes, and skin. In mice and guinea pigs the lethal concentration for 1-hour exposure was about 5000 ppm; irritation of the eyes and respiratory tract occurred above 100 ppm. Exposure to 50 ppm or more is intolerable to most persons and results in intense lacrimation and irritation of the eyes, nose, and throat, with pharyngeal edema and chronic bronchitis. Unacclimatized humans experience extreme eye and nasal irritation at concentrations in excess of 25 ppm; con-

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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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conjunctivitis from concentrations below 10 ppm has been reported. In a study of five workers exposed for 7 to 12 years to concentrations of 80 to 200 ppm at peaks, the principal findings were blackening and hyperkeratosis of the skin of the hands, conjunctivitis (but no corneal damage), bronchitis and pharyngitis, and erosion of the exposed teeth (incisors and canines). Glacial (100%) acetic acid caused severe injury when applied to the eyes of rabbits; in humans it has caused permanent corneal opacification. A splash of vinegar (4 to 10% acetic acid solution) in the human eye causes immediate pain and conjunctival hyperemia, sometimes with injury of the corneal epithelium. On the guinea pig skin, the liquid in concentrations in excess of 80% produces severe burns; concentrations of 50 to 80% produce moderate to severe burns; solutions below 50% cause relatively mild injury; no injury is produced by 5 to 10% solution. Skin sensitization is rare but has been reported. Although ingestion is unlikely to occur in industrial use, as little as 1.0 ml of glacial acetic acid has resulted in perforation of the esophagus.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 60.05
2. Boiling point (760 mm Hg): 118 C (244 F)
3. Specific gravity (water = 1): 1.05
4. Vapor density (air = 1 at boiling point of acetic acid): 2.1
5. Melting point: 16.6 C (62 F)
6. Vapor pressure at 20 C (68 F): 11 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): 0.97

### • Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers (especially chromic acid, sodium peroxide, and nitric acid) may cause fires and explosions. Contact with strong caustics will cause violent spattering.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving acetic acid.

4. Special precautions: Liquid acetic acid will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Flash point: 40 C (104 F) (closed cup)
2. Autoignition temperature: 427 C (800 F)
3. Flammable limits in air, % by volume at 100 C (212 F): Lower; 5.4; Upper: 16.0
4. Extinguishant: Carbon dioxide, dry chemical, alcohol foam

### • Warning properties

1. Odor Threshold: May reports an odor threshold of 24 ppm; Patty reports 10 ppm; the Manufacturing Chemists Association reports 1 ppm; Gleason reports 0.2 to 1 ppm.

2. Eye Irritation Level: Grant reports that "the

vapor of acetic acid is irritating to the eyes and nose, causing lacrimation and hyperemia." Patty reports that workers exposed to 80 to 200 ppm for 7 to 12 years suffered "conjunctivitis (but no corneal damage)." The *Documentation of TLV's* states that "Baldi reported conjunctival irritation from concentrations below 10 ppm." It notes that the TLV of 10 ppm is suggested in order to "prevent undue irritation." The *AIHA Hygienic Guide* also states that eye irritation occurs at 10 to 15 ppm.

3. Other Information: Grant reports that the vapor of acetic acid is irritating to the nose. Also, workers exposed to 80 to 200 ppm for 7 to 12 years experienced congestion of the pharynx. No other quantitative information is given. The *Hygienic Guide* states that "unacclimatized humans experience extreme eye and nasal irritation at concentrations in excess of 25 ppm. Effects at 50 ppm are intolerable and usually result in immediate running from the area." Nasal irritation occurs at 10 to 15 ppm," according to the *Hygienic Guide*.

4. Evaluation of Warning Properties: Since the odor of acetic acid can be detected at a level either below or slightly above the permissible exposure limit, and since the *Documentation of TLV's* reports that eye irritation has been noted at a concentration below 10 ppm, acetic acid is treated as a material with adequate 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

An analytical method for acetic acid is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

## 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 solid or liquid acetic acid or solutions containing 50% or more of acetic acid by weight and to prevent repeated or prolonged skin contact with solutions containing 10% or more but less than 50% of acetic acid by weight.

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

- Where there is any possibility of exposure of an employee's body to solid or liquid acetic acid or solutions containing 50% or more of acetic acid by weight, 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 solid or liquid acetic acid or solutions containing 50% or more of acetic acid by weight should be removed immediately and not reworn until the acetic acid is removed from the clothing.

- Non-impervious clothing which becomes contaminated with solutions containing less than 50% but greater than 10% of acetic acid by weight should be removed promptly and not reworn until the acetic acid is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of solid or liquid acetic acid or solutions containing acetic acid contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to solid or liquid acetic acid or solutions containing 50% or greater acetic acid by weight, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with solid or liquid acetic acid or solutions containing 50% or more of acetic acid by weight should be immediately washed or showered to remove any acetic acid.

- Skin that becomes contaminated with solutions containing less than 50% but greater than 10% acetic acid by weight should be promptly washed or showered to remove any acetic acid.

- Employees who handle solid or liquid acetic acid or solutions containing acetic acid should wash their hands thoroughly before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in production of acetic anhydride for cellulose acetate, fibers, plastics, and aspirin; use in production of vinyl acetate for polymers, coatings, and adhesives	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in production of acetic esters for solvents in plastics, coatings, and pharmaceutical industries	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in chemical industry as an esterifying agent, acetylating agent, solvent, and reaction medium; as an acidifying and neutralizing agent	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in food canning industries as a food additive or flavorant for pickles, fish, meat, candy, and glazes	General dilution ventilation; personal protective equipment
Use in manufacture and processing of acetic acid; use in textile and dye industries as a solvent, acidifying and neutralizing agent, intermediate in production of dyestuffs, dye catalysts, textile finishing, dye after-treatment, and production of nylon and acrylic fibers	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

## Operation

## Controls

Use in photographic industry in manufacture of photographic chemicals; constituent of photographic fixing baths, hardeners, hypotest solutions, and constituent of microfilm cements

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in pharmaceutical industry in production of vitamins, antibiotics, hormones, and reaction solvent

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in rubber industry in manufacture of rubber chemicals, accelerators, and coagulant of natural latex

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in dry cleaning and laundry industries to remove rust from garments; laundry sour to adjust pH in final operations

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use as a laboratory reagent in chemical and biochemical analysis; in field testing of lead fume, vinyl chloride determination, uric acid in urine, aniline vapors, and separation of gases

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in miscellaneous applications for etching compounds for engraving; deliming agent during leather tanning, solvent for organic compounds, and oil well acidizer

Process enclosure; local exhaust ventilation; general dilution 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 solid or liquid acetic acid or solutions containing acetic acid get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately.

Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If solid or liquid acetic acid or solutions containing acetic acid get on the skin, immediately flush the contaminated skin with water. If solid or liquid acetic acid or solutions containing acetic acid penetrate through the clothing, remove the clothing immediately and flush the skin with water. Get medical attention promptly.

### • Breathing

If a person breathes in large amounts of acetic acid, 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

If solid or liquid acetic acid or strong solutions of acetic acid have been swallowed and the person is conscious, give him large quantities of water immediately to dilute the acetic acid. Do not attempt to make the exposed 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 acetic acid is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. If in the liquid form, 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, or diluted, and then neutralized with caustic solution and flushed into a sewer. Unneutralized, combustible acetic acid should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

4. If in the solid form, collect in the most safe and convenient manner for reclamation or allow to melt and collect as in (3) above.

• Waste disposal method:

Acetic acid may be disposed of by atomizing in a suitable combustion chamber, or diluted and then neutralized with caustic solution and flushed into a sewer.

## REFERENCES

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## RESPIRATORY PROTECTION FOR ACETIC ACID

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Vapor Concentration	
500 ppm or less	<p>Any chemical cartridge respirator with a full facepiece and an 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>
1000 ppm or less	<p>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.</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 pressure mode.</p>
Fire Fighting	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p>
Escape	<p>Any gas mask providing protection against organic vapors.</p> <p>Any escape self-contained breathing apparatus.</p>

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

