OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ACETALDEHYDE

INTRODUCTION

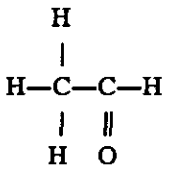
This guideline summarizes pertinent information about acetaldehyde for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

- **Formula**

CH_3CHO

- **Structure**



- **Synonyms**

Acetic aldehyde, ethanal, acetylaldehyde, ethyl aldehyde

- **Identifiers**

1. CAS No.: 75-07-0
2. RTECS No.: AB1925000
3. DOT UN: 1089 26
4. DOT label: Flammable Liquid

- **Appearance and odor**

Acetaldehyde is a colorless, flammable, volatile liquid or gas (above 69°F) with a pungent, fruity odor detectable at low concentrations. The odor threshold is reported to be between 0.05 and 2.3 parts per million (ppm) parts of air.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 44.1
2. Boiling point (at 760 mm Hg): 21°C (69.8°F)
3. Specific gravity (water = 1): 0.79 at 20°C (68°F)
4. Vapor density (air = 1 at boiling point of acetaldehyde): 1.5
5. Melting point: -123.5°C (-190.3°F)
6. Vapor pressure at 20°C (68°F): 740 mm Hg
7. Solubility: Miscible with water, alcohol, ether, acetone, benzene, gasoline, solvent naphtha, toluene, turpentine, and xylene
8. Evaporation rate (ether = 1): 3

- **Reactivity**

1. Conditions contributing to instability: Contact of acetaldehyde with air may cause the formation of explosive peroxides, and contact of this substance with heat or flame may cause fires or explosions. Contact with trace metals or alkaline materials may cause acetaldehyde to undergo hazardous polymerization.

2. Incompatibilities: Fire and explosion may result from contact of acetaldehyde with strong oxidizers. Acetaldehyde reacts vigorously with acid anhydrides, alcohols, anhydrous ammonia, amines, ketones, phenols, hydrogen cyanide, hydrogen sulfide, halogens, phosphorus, isocyanates, and strong alkalies.

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

4. Special precautions: Liquid acetaldehyde attacks some coatings and some forms of plastic and rubber.

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Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

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

• **Flammability**

The National Fire Protection Association has assigned a flammability rating of 4 (extreme fire hazard) to acetaldehyde.

1. Flash point: −37.8°C (−36°F) (closed cup)

2. Autoignition temperature: 175°C (347°F)

3. Flammable limits in air (% by volume): Lower, 4.0; upper, 60.0

4. Extinguishant: Use dry chemical, carbon dioxide, or alcohol foam to fight fires involving acetaldehyde. Water may be ineffective, but it may be used to keep fire-exposed containers cool and to protect persons attempting to stop the leak. If a leak or spill of acetaldehyde has not ignited, water spray may be used to disperse vapors.

Fires involving acetaldehyde should be fought upwind and from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapor explosion and poison hazards may occur indoors, outdoors, or in sewers. Vapors may travel to a source of ignition and flash back. Containers of acetaldehyde may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if they hear a rising sound from a venting safety device or if a container becomes discolored as a result of fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half mile in all directions. Firefighters should wear a full set of protective clothing (including a self-contained breathing apparatus) when fighting fires involving acetaldehyde. Firefighters' protective clothing may provide limited protection against fires involving acetaldehyde.

EXPOSURE LIMITS

• **OSHA PEL**

The current Occupational Safety and Health Adminstration (OSHA) permissible exposure limit (PEL) for acetaldehyde is 100 ppm (180 mg/m^3) as an 8-hr TWA concentration and 150 ppm (270 mg/m^3) as a short-term exposure limit (STEL). A STEL is a 15-min TWA exposure which should not be exceeded at any time during the working day [29 CFR 1910.1000, Table Z-1-A].

• **NIOSH REL**

The National Institute for Occupational Safety and Health (NIOSH) considers acetaldehyde to be a potential occupational carcinogen and recommends exposures be controlled to the lowest feasible limit [NIOSH 1992].

• **ACGIH TLV®**

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned an acetaldehyde threshold limit value (TLV) of 100 ppm (180 mg/m^3) as a TWA for a normal 8-hr workday and a 40-hr workweek and a STEL of 150 ppm (270 mg/m^3) for periods not to exceed 15 min [ACGIH 1991b].

• **Rationale for limits**

The OSHA and ACGIH limits are based on the risk of conjunctivitis and sensory irritation of the respiratory tract associated with exposure to acetaldehyde. The NIOSH limit is based on positive carcinogenic results in animal studies.

HEALTH HAZARD INFORMATION

• **Routes of exposure**

Exposure to acetaldehyde can occur through inhalation, ingestion, or contact with the eyes, skin, or mucous membranes.

• **Summary of toxicology**

1. *Effects on Animals*: Acetaldehyde is an irritant of the eyes, mucous membranes, and upper respiratory tract in animals; at high concentrations, it is a central nervous system depressant. Acetaldehyde has caused squamous cell carcinomas and adenocarcinomas of the nasal cavity in rats and hamsters; it is also embryotoxic and teratogenic in several species of animals. Acetaldehyde causes severe irritation when applied to the eyes of rabbits; it causes mild irritation in contact with skin [NIOSH 1991]. In rats, the oral LD_{50} is 661 mg/kg, and the LC_{50} is 37 g/m^3 (20,550 ppm) for 30 min [NIOSH 1991]. Cats exposed to 380 ppm for 7 hr showed no effects; but increasing the concentration to 1,520 ppm caused signs of respiratory tract irritation [ACGIH 1991a]. Rats exposed to concentrations ranging from 400 to 5,000 ppm for 6 hr/day, 5 days/week for 4 weeks showed slight degeneration of the nasal epithelium at 400 ppm, and growth retardation, increased urinary output (in males only), and slight-to-moderate degeneration (with or without hyperplasia and metaplasia) of the nasal epithelium at 1,000 or 2,200 ppm [IARC 1985]. The rats exposed to 5,000 ppm showed severe growth retardation, increased neutrophil counts, reduced urine volumes, increased lung weights, and severe degenerative hyperplasia and metaplasia of the nasal, laryngeal, and tracheal epithelium [NLM 1992]. Hamsters were exposed to acetaldehyde concentrations ranging from 390 to 4,560 ppm for 6 hr/day, 5 days/week for 90 days. At the lowest concentration, these animals showed no toxic effects; at the highest concentration, however, they showed signs of eye and nose irritation, growth retardation, and erythrocytosis. At autopsy, these high-dose animals showed

increased kidney and heart weights and severe histopathologic changes of the respiratory epithelium [IARC 1985]. Fetal malformations (facial and cranial), digital anomalies, and embryonic deaths (resorptions) occurred in the offspring of rats and mice from dams treated with acetaldehyde during pregnancy [IARC 1985]. Acetaldehyde has been tested for carcinogenicity in rats by inhalation and in hamsters by inhalation and intratracheal administration. In rats, inhalation of acetaldehyde caused a statistically significant increase in the incidence of nasal adenocarcinomas and squamous cell carcinomas of the lungs. In hamsters, inhalation caused a significant increase in the incidence of laryngeal carcinoma, and intratracheal injections resulted in the induction of "peribronchiolar adenomated lesions," which were apparently not classified as tumors. The International Agency for Research on Cancer (IARC) has concluded that there is sufficient evidence for the carcinogenicity of acetaldehyde in animals [IARC 1987]. Acetaldehyde is mutagenic in bacterial and mammalian test systems with and without activation [NIOSH 1991].

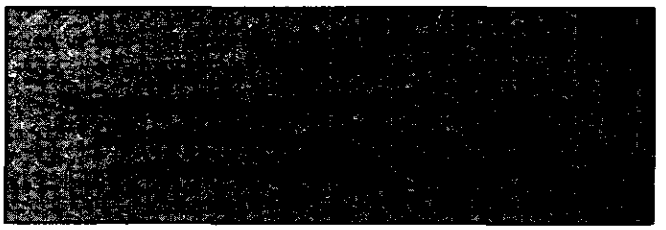
2. *Effects on Humans*: Acetaldehyde is an irritant of the eyes, mucous membranes, skin, and upper respiratory tract, and it is a central nervous system depressant in humans. On the basis of effects seen in animals, acetaldehyde is a potential carcinogen in humans. Although sensitive individuals experienced irritation when exposed to 25 ppm for 15 min, most unacclimated human volunteers exposed to 50 ppm experienced mild eye irritation, and all subjects exposed to 200 ppm developed conjunctivitis [Proctor et al. 1988]. Upper respiratory tract irritation was reported at a vapor concentration of 134 ppm [Proctor et al. 1988]. Eye contact with liquid acetaldehyde causes a burning sensation and superficial corneal injury; exposure to concentrations above 50 ppm may cause persistent tearing, photophobia, and injury to the corneal epithelium [Grant 1986]. Acetaldehyde causes erythema when splashed on the skin; if contact is repeated or prolonged, this substance may cause dermatitis or skin burns [Proctor et al. 1988]. A study of East German workers exposed to acetaldehyde and other chemicals in a chemical factory showed an increase in the number of cancers of the bronchial tubes and oral cavity. However, IARC has concluded that the results of this study are inconclusive because the workers were exposed to other chemicals and only a small, poorly defined population was involved [IARC 1987].

- **Signs and symptoms of exposure**

1. *Acute exposure*: Acute exposure to acetaldehyde can cause irritation of the eyes with burning, conjunctivitis, tearing, blurred vision, and photophobia; irritation and burning of the nose with rhinorrhea; and irritation of the upper respiratory tract with pain and coughing. Exposure to high levels of this substance may cause headache, drowsiness, dizziness, excitement, and agitation, followed by narcosis or stupor, pulmonary edema, and possibly death resulting from respiratory failure; however, ingestion can also induce nausea, vomiting, and diarrhea. Skin contact may cause dermatitis and burns of the exposed area.

2. *Chronic exposure*: Chronic exposure to acetaldehyde can cause conjunctivitis, coughing, difficult breathing, and dermatitis. On the basis of effects seen in animals, chronic exposure to acetaldehyde may cause heart and kidney damage, embryotoxicity, teratogenic effects, and possibly cancer in humans.

- **Emergency procedures**



Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure*: Tissue irritation may result from exposure to concentrated solutions, vapors, mists, or aerosols of acetaldehyde. ***Immediately and thoroughly*** flush eyes with large amounts of water, occasionally lifting the upper and lower eyelids.

2. *Skin exposure*: Skin irritation may result. ***Immediately*** remove contaminated clothing and ***thoroughly*** wash contaminated skin with soap and water.

3. *Inhalation exposure*: If vapors, mists, or aerosols of acetaldehyde are inhaled, move the victim to fresh air ***immediately.***

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure*: Take the following steps if acetaldehyde or a solution containing it is ingested:

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.

—Have the victim drink a glass (8 oz) of fluid such as water.

—Induce vomiting by giving syrup of ipecac as directed on the package. If ipecac is unavailable, have the victim touch the back of the throat with a finger until productive vomiting ceases.

—Do ***not*** force an unconscious or convulsing person to drink fluid or to vomit.

5. *Rescue*: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve acetaldehyde and may result in worker exposures to this substance:

—Synthesis of acetic acid, acetic anhydride, acrolein, aldol, butanol, butylene glycol, chloral, crotonaldehyde, 2-ethylhexanol, metaldehyde, paraldehyde, pentaerythritol, peracetic acid, pyridines, and trimethylolpropane

—Manufacture of synthetic resins, aniline dyes, herbicides, fungicides, other pesticides, explosives, and pharmaceuticals

—Synthesis of rubber processing chemicals, disinfectants, cosmetics, and perfumes

—Use of acetaldehyde in silvering mirrors and as an alcohol denaturant

—Use of acetaldehyde as a hardening agent in photography and in the manufacture of gelatin, glue, lacquers, varnishes, and casein products

—Use of acetaldehyde as a flavoring agent and additive in milk products and candies and as a preservative for food and leather

The following methods are effective in controlling worker exposures to acetaldehyde, depending on the feasibility of implementation:

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. Industrial ventilation—a manual of recommended practice. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

2. Burton DJ [1986]. Industrial ventilation—a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.

4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.

5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety or health, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

• Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to acetaldehyde, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, and respiratory tract. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to acetaldehyde at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with eye, skin, and respiratory tract diseases.

- **Periodic medical examinations and biological monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to acetaldehyde exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of acetaldehyde on the eyes, skin, and respiratory tract. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissue or fluids to provide an index of exposure to a toxic substance or metabolite. Acetaldehyde can be detected in the blood, urine, and breath of exposed individuals. However, aldehyde concentrations in these biological specimens have not been correlated with airborne concentrations of this substance. Therefore, no biological monitoring method acceptable for routine use has yet been developed for acetaldehyde.

- **Medical examinations recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of job placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population. Because occupational exposure to acetaldehyde may cause diseases with prolonged latent periods, the need for medical monitoring may extend well beyond the termination of employment.

WORKPLACE MONITORING AND MEASUREMENT

A worker's exposure to airborne acetaldehyde is determined by using a silane-treated glass tube that is packed with a 225-mg backup section and a 450-mg sampling section of pretreated XAD-2 adsorbent coated with 10% (by weight) 2-(hydroxymethyl)piperidine. Samples are collected at a maximum flow rate of 0.05 liter/min until a maximum air volume of 3 liters is collected (8-hr TWA), or they are collected at a maximum flow rate of 0.05 liter/min until a maximum air volume of 0.75 liter is collected (STEL). Analysis is conducted by gas chromatography using a nitrogen/phosphorus detector. The limit of detection for this procedure is 580 parts per billion. This method is described in the OSHA Computerized Information System [OSHA 1990]. A similar method for sampling and analyzing acetaldehyde is included in Method 2538 of the *NIOSH Manual of Analytical Methods* [NIOSH 1984].

PERSONAL HYGIENE

If acetaldehyde contacts the skin, workers should immediately flush the affected areas with large amounts of water and then wash with soap and water.

Clothing and shoes contaminated with acetaldehyde should be removed immediately, and provisions should be made for safely removing this chemical from these articles. Persons laundering contaminated clothing should be informed of the hazardous properties of acetaldehyde, particularly its potential for causing skin or eye burns on prolonged contact.

A worker who handles acetaldehyde should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.

Workers should not eat, drink, or use tobacco products in areas where acetaldehyde or a solution containing acetaldehyde is handled, processed, or stored.

STORAGE

Acetaldehyde should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. Bulk quantities of acetaldehyde should be stored outside in detached, refrigerated tanks that conform to the requirements of the hazard communication standard. Storage in an inert gas atmosphere is recommended. Only nonsparking tools and equipment should be used to handle this OSHA Class IA flammable liquid. Containers of acetaldehyde should be protected from physical damage and should be stored separately from alkaline materials, acids, halogens, alcohols, ammonia, amines, ketones, hydrogen sulfide, hydrogen cyanide, acid anhydrides, phenols, oxidizing agents, and all ignition sources. All electrical service in storage areas should be of explosionproof design. To prevent static sparks, containers and equipment used to transfer acetaldehyde should be electrically grounded and bonded. Because empty containers may contain acetaldehyde residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving acetaldehyde, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup is complete.

The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.

2. Notify safety personnel.

3. Remove all sources of heat and ignition.

4. Provide maximum explosionproof ventilation to ventilate area of leak or spill.

5. Use nonsparking tools during cleanup.

6. Use water spray to flush spills away from workers and to dilute the spill.

7. Absorb small liquid spills with paper towels, vermiculite, or sand and place the material in a covered container for later disposal.

8. For large liquid spills, build dikes far ahead of the spill to contain the acetaldehyde for later reclamation or disposal.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

- **Emergency planning requirements**

Acetaldehyde is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

- **Reportable quantity requirements for hazardous releases**

A hazardous substance release is defined by EPA as any spilling, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of hazardous substances into the environment (including the abandonment or discarding of contaminated containers). In the event of a release that is above the reportable quantity for that chemical, employers are required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the proper Federal authorities.

The reportable quantity for acetaldehyde is 1,000 lb. If an amount equal to or greater than this quantity is released within a 24-hr period in a manner that will expose persons outside the facility, employers are required to do the following:

—Notify the National Response Center ***immediately*** at (800) 424-8802 or at (202) 426-2675 in Washington, D.C. [40 CFR 302.6].

—Notify the emergency response commission of the State likely to be affected by the release [40 CFR 355.40].

—Notify the community emergency coordinator of the local emergency planning committee (or relevant local emergency response personnel) of any area likely to be affected by the release [40 CFR 355.40].

- **Community right-to-know requirements**

Employers who own or operate facilities in SIC codes 20 to 39, who employ 10 or more workers, and who manufacture 25,000 lb or more or otherwise use 10,000 lb or more of acetaldehyde per calendar year are required by EPA [49 CFR 372.30] to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of acetaldehyde emitted or released from their facility annually.

- ***Hazardous waste management requirements***

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Acetaldehyde is listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [42 USC 6901 et seq.] and has been assigned EPA Hazardous Waste No. U001. This substance has been banned from land disposal and may be treated by fuel substitution or incineration. Acetaldehyde may also be disposed of in an organometallic or organic lab pack that meets the requirements of 40 CFR 264.316 or 265.316.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of acetaldehyde are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

- **Conditions for respirator use**

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of acetaldehyde exceeds

prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

- **Respiratory protection program**

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Gloves and protective clothing should be worn to prevent skin contact with acetaldehyde. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. The following materials have been tested against permeation by acetaldehyde and have demonstrated good-to-excellent resistance: Teflon®, butyl rubber, and polyethylene/ethylene vinyl alcohol. Butyl rubber may provide more than 8 hr of resistance to permeation by acetaldehyde. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol, polyvinyl chloride, and Viton® have demonstrated poor resistance to permeation by acetaldehyde.

If acetaldehyde is dissolved in water or an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Splashproof safety glasses, goggles, or face shields should be worn during operations in which there is any possibility of eye contact with acetaldehyde. Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with this substance. Contact lenses should not be worn if the potential exists for acetaldehyde exposure.

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