

# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIACETONE ALCOHOL

## INTRODUCTION

This guideline summarizes pertinent information about diacetone alcohol for workers, employers, and 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 Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

## SUBSTANCE IDENTIFICATION

- **Formula:**  $C_6H_{12}O_2$
- **Structure:**  $(CH_3)_2C(OH)CH_2COCH_3$
- **Synonyms:** Diketone alcohol; 4-hydroxy-2-keto-4-methylpentane; 4-hydroxy-4-methyl-2-pentanone; 2-methyl-2-pentanol-4-one
- **Identifiers:** CAS 123-42-2; RTECS SA9100000; DOT 1148, label required: "Flammable Liquid"
- **Appearance and odor:** Colorless to yellow liquid with a mild odor

## CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 116.62
  2. Boiling point (at 760 mmHg): 169.2°C (335°F)
  3. Specific gravity (water = 1): 0.94
  4. Vapor density (air = 1 at boiling point of diacetone alcohol): 4.0
  5. Melting point: -43°C (-45°F)
  6. Vapor pressure: At 20°C (68°F), 0.8 mmHg; at 25°C (77°F), 1.2 mmHg
  7. Miscible in water
  8. Evaporation rate (butyl acetate = 1): 0.14
  9. Saturation concentration in air (approximate) at 20°C (68°F): 0.10% (1,000 ppm); at 25°C (77°F), 0.16% (1,600 ppm)

- **Reactivity**

1. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong alkalies may cause formation of flammable acetone vapors.
2. Hazardous decomposition products: Toxic vapors and gases (e.g., carbon monoxide) may be released in a fire involving diacetone alcohol.
3. Caution: Diacetone alcohol will dissolve some forms of plastics, resins, and rubber.

- **Flammability**

1. Flash point: 57.8°C (136°F) (closed cup)
2. Autoignition temperature: 643°C (1,190°F)
3. Flammable limits in air, % by volume: Lower, 1.8; upper, 6.9
4. Extinguishant: Carbon dioxide, dry chemical, or alcohol foam
5. Class II Combustible Liquid (29 CFR 1910.106), Flammability Rating 2 (NFPA)

- **Warning properties**

1. Odor threshold: 0.28 ppm
2. Eye irritation level: 100 ppm
3. Other information: Nasal irritation may occur at 100 ppm.
4. Evaluation of warning properties for respirator selection: Because of its odor, diacetone alcohol can be detected below the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL); thus, it is treated as a chemical with adequate warning properties.

## EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for diacetone alcohol is 50 parts of diacetone alcohol per million parts of air (ppm) [240 milligrams of diacetone alcohol per cubic meter of air ( $mg/m^3$ )] as a time-weighted average (TWA) concentration over an 8-hour workshift. The NIOSH REL is 50 ppm (240  $mg/m^3$ ) as a TWA for up to a 10-hour workshift, 40-hour workweek. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV<sup>®</sup>) is 50 ppm (240  $mg/m^3$ ) as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1).

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service      Centers for Disease Control  
National Institute for Occupational Safety and Health  
Division of Standards Development and Technology Transfer

**Table 1.—Occupational exposure limits for diacetone alcohol**

	Exposure limits	
	ppm	mg/m <sup>3</sup>
OSHA PEL TWA	50	240
NIOSH REL TWA	50	240
ACGIH TLV® TWA	50	240

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Diacetone alcohol may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

### • Summary of toxicology

*Effects on animals:* In rats and rabbits, acute oral administration or inhalation of diacetone alcohol caused narcosis, kidney damage, and liver damage (vacuolization and granulation of parenchymal cells).

### • Signs and symptoms of exposure

1. *Short-term (acute):* Exposure to diacetone alcohol can cause chest discomfort, narcosis, and irritation of the eyes, nose, and throat.
2. *Long-term (chronic):* Exposure to diacetone alcohol can cause dryness, irritation, and inflammation of the skin.

## RECOMMENDED MEDICAL PRACTICES

### • Medical surveillance program

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control 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 and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) 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 surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals,

potentially exposed workers, and regulatory and public health agencies.

### • Preplacement medical evaluation

Prior to placing a worker in a job with a potential for exposure to diacetone alcohol, the physician 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, liver, kidneys, and nervous and respiratory systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to diacetone alcohol at or below the NIOSH REL. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include concurrent dermatitis or a history of chronic skin disease.

### • Periodic medical screening and/or biologic monitoring

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to diacetone alcohol. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the physiologic function of the eyes, skin, liver, kidneys, and nervous and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population. The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and the ATS: standardized questionnaires and tests of lung function.

### • Medical practices 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 which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population.

### • Sentinel health events

Acute SHE's include: Contact and/or allergic dermatitis.

## MONITORING AND MEASUREMENT PROCEDURES

### • TWA exposure evaluation

Measurements to determine worker exposure to diacetone alcohol should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of

consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

• **Method**

Sampling and analysis may be performed by collecting diacetone alcohol vapors with charcoal tubes followed by desorption with 2-propanol in carbon disulfide and analysis by gas chromatography. Detector tubes or other direct-reading devices calibrated to measure diacetone alcohol may also be used if available. A detailed sampling and analytical method for diacetone alcohol may be found in the *NIOSH Manual of Analytical Methods* (Method number 1402).

**PERSONAL PROTECTIVE EQUIPMENT**

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, face shields (8-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with diacetone alcohol.

Workers should be provided with and required to use splash-proof goggles where diacetone alcohol may come in contact with the eyes.

**SANITATION**

Clothing which is contaminated with diacetone alcohol should be removed immediately and placed in closed containers for storage until it can be discarded or until provision is made for the removal of diacetone alcohol from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of diacetone alcohol's hazardous properties.

Change and shower rooms should be provided with separate locker facilities for street and work clothes.

Skin that becomes contaminated with diacetone alcohol should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle diacetone alcohol should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

**COMMON OPERATIONS AND CONTROLS**

Common operations in which exposure to diacetone alcohol may occur and control methods which may be effective in each case are listed in Table 2.

**Table 2.—Operations and methods of control for diacetone alcohol**

Operations	Controls
During application of nitrocellulose lacquer	Process enclosure, local exhaust ventilation, personal protective equipment
During application of paper and textile coatings, wood stains, and preservatives; during use and manufacture of artificial silk and leather, quick-drying inks, photographic film, antifreeze preparations, and hydraulic fluids	Local exhaust ventilation, general dilution ventilation, personal protective equipment
During use as a solvent for cellulose esters, epoxy resins, hydrocarbons, oils, fats, resin gums, dyes, tars, cements, and waxes; during use as a pigment solvent in the dyeing industry	Local exhaust ventilation, general dilution ventilation, personal protective equipment

**EMERGENCY FIRST AID PROCEDURES**

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

• **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to diacetone alcohol, an eye-wash fountain should be provided within the immediate work area for emergency use.

If diacetone alcohol gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• **Skin exposure**

Where there is any possibility of a worker's body being exposed to diacetone alcohol, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If diacetone alcohol gets on the skin, wash it immediately with soap and water. If diacetone alcohol penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

• **Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. 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.

## SPILLS AND LEAKS

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

If diacetone alcohol 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 of liquids containing diacetone alcohol, absorb on paper towels and place in an appropriate container. Place towels in a safe place such as a fume hood for evaporation. Allow sufficient time for evaporation of the vapors so that the hood ductwork is free from diacetone alcohol vapors. Burn the paper in a suitable location away from combustible materials.
4. Large quantities of liquids containing diacetone alcohol may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container. Diacetone alcohol should not be allowed to enter a confined space such as a sewer because of the possibility of an explosion.
5. Liquids containing diacetone alcohol may be collected by vacuuming with an appropriate system. If a vacuum system is used, there should be no sources of ignition in the vicinity of the spill, and flashback prevention devices should be provided.

## WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

## RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations, including those requiring confined-space entry (Table 3).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards, 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

For each level of respiratory protection, only those respirators that have the minimum required protection factor and meet other use restrictions are listed. All respirators that have higher protection factors may also be used.

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**Table 3.—Respiratory protection for diacetone alcohol**

Condition	Minimum respiratory protection*†
Concentration:	
Less than or equal to 1,000 ppm	Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s) Any powered air-purifying respirator with organic vapor cartridge(s) (substance causes eye irritation or damage—eye protection needed)
Less than or equal to 1,250 ppm	Any supplied-air respirator operated in a continuous flow mode (substance causes eye irritation or damage—eye protection needed)
Less than or equal to 2,100 ppm	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister Any self-contained breathing apparatus with a full facepiece Any supplied-air respirator with a full facepiece
Planned or emergency entry into environments containing unknown concentrations or levels above 2,100 ppm	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister Any appropriate escape-type self-contained breathing apparatus

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

†The respiratory protection listed for any given condition is the minimum required to meet the NIOSH REL of 50 ppm (240 mg/m<sup>3</sup>) (TWA).

