

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** DIACETONE ALCOHOL ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance DIACETONE ALCOHOL.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

(a) DEFINITIONS

- (1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of diacetone alcohol in concentrations not in excess of 50 parts per million (ppm) (240 milligrams per cubic meter, mg/cu.m.) averaged over an eight hour work shift, as stated in section 1910.93, Table G-1.
- (2) ACTION LEVEL - "Action Level" means one half (1/2) of the permissible exposure for diacetone alcohol.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which diacetone alcohol is present shall:

- (1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices A, B and C, at the workplace. This material shall be made readily available to affected employees; and
- (2) PRESENCE OF DIACETONE ALCOHOL - Inform affected employees of the quantity, location, and manner of use or storage of diacetone alcohol.

(c) EXPOSURE MEASUREMENT

- (1) INITIAL DETERMINATION - Each employer who has a place of employment in which diacetone alcohol is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of diacetone alcohol at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of diacetone alcohol. A written determination shall be made and it shall contain at least the following information:
 - (i) Any information, observations, or calculations which would indicate employee exposure to diacetone alcohol;
 - (ii) Any measurements of airborne concentrations of diacetone alcohol taken;
 - (iii) Any employee complaints of symptoms which may be attributable to exposure to diacetone alcohol; and
 - (iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.
- (2) INITIAL EXPOSURE MEASUREMENT - If the employer determines that any employee may be exposed to airborne concentrations of diacetone alcohol at or above the action level, the exposure of the employee believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum exposure of the employee.
- (3) IDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of diacetone alcohol at or above the action level, the employer shall:
 - (i) Identify all employees who may be exposed at or above the action level; and
 - (ii) Measure the exposure of the employees so identified.
- (4) EXPOSURE ABOVE THE ACTION LEVEL - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of diacetone alcohol at or above the action level,

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

- (5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of diacetone alcohol above the permissible exposure, the employer shall:

- (i) Inform the employee of the exposure as required by paragraph (N)(1) of this section; and
- (ii) Measure the exposure of the employee at least monthly; and
- (iii) Institute control measures as required by paragraph (E) of this section.

- (6) TERMINATION OF EXPOSURE MEASUREMENT - If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to airborne concentrations of diacetone alcohol below the action level, the employer may terminate measurement for the employee. For purposes of this subparagraph, use of respirators shall not constitute reduction of employee exposure below the action level.

- (d) METHODS OF MEASUREMENT - An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight hour work shift (Appendix B (iv)). The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1 below.

Table 1

Concentration	Required Accuracy
Above permissible exposure	Plus or Minus 25%
At or below permissible exposure and above the action level	Plus or Minus 35%
At or below the action level	Plus or Minus 50%

- (e) Methods of Compliance

- (1) Engineering controls - No employee shall be exposed to diacetone alcohol above the permissible limit as defined in paragraph (a)(1) of this section. Engineering and work practice controls shall be used to reduce exposure to diacetone alcohol to at or below the permissible exposure.

- (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system efficiency (for example: air velocity, static pressure, or air volume) shall be made at least every three months. Measurements of system efficiency shall also be made within five work days of any change in production, process or control which might result in a reduction in control.

- (ii) In the design of open surface tank ventilation for the purposes of section 1910.94 (d), operations involving diacetone alcohol shall be classified as B-4 at 70 F.

- (iii) Where a fan is located in duct work and where diacetone alcohol is present in concentrations greater than 4500 ppm, one fourth of the lower flammable limit, the fan rotating element shall be of non-sparking material or the casing shall consist of, or be lined with, non-sparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

(2) Respirators

- (i) Compliance with the permissible exposure may not be achieved by the use of respirators except:
 - (a) During the time period necessary to install engineering controls; or
 - (b) In work situations in which engineering controls are technically not feasible; or
 - (c) In work situations in which feasible engineering and work practice controls are insufficient to reduce employees exposure to at or below the permissible exposure. Where technically feasible engineering and work practice controls are not sufficient to reduce exposure to at or below permissible exposure, they shall be used to reduce exposure to the lowest level feasible; or
 - (d) For operations not exceeding 40 hours per year; or
 - (e) In emergencies.
- (ii) Respirators shall be jointly approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.
- (iii) Employers shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.
- (iv) Employers shall institute a respiratory protection program in accordance with sections 1910.134(b),(d),(e) and (f).

TABLE 2. RESPIRATORY PROTECTION FOR DIACETONE ALCOHOL

Condition

Vapor Concentration

Equal to or less
than 1000 ppm

organic vapor cartridge(s).

Equal to or less
than 1500 ppm

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
1500 ppm, or
Entry & Escape

Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.

air respirator with a full facepiece operated in pressure-demand (positive pressure) or continuous flow mode and an

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

auxiliary self-contained air supply operated in pressure-demand mode.

Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.

Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

(f) Fire and Safety

Employers shall familiarize themselves with the information contained in the Substance Technical Guidelines for diacetone alcohol which is contained in Appendix B in order to ensure the safe handling and use of diacetone alcohol.

- (1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of diacetone alcohol shall be Class I Group D.
- (2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, diacetone alcohol is classified as a Class B fire hazard.
- (3) Powered industrial trucks - For the purposes of compliance with section 1910.178, locations classified as hazardous locations due to the presence of diacetone alcohol shall be Class I Group D.
- (4) Combustible liquids - For the purposes of compliance with section 1910.106, liquid diacetone alcohol is classified as a Class II combustible liquid. Spray finishing operations shall be performed in accordance with sections 1910.107 and 1910.94(c). Dip tank operations shall be performed in accordance with sections 1910.108 and 1910.94(d).
- (5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where diacetone alcohol is handled, used or stored in a manner so as to create a potential fire or explosion hazard.
- (6) Storage - Diacetone alcohol shall be stored so as not to come in contact with strong oxidizers or strong alkalies.

(g) Personal Protective Equipment

(1) Skin Contact

- (i) Employers shall provide, and require employees to use, impervious clothing, gloves, face shields (8 inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact to liquid diacetone alcohol. Face shields shall comply with section 1910.133(a)(6).
- (ii) Employers shall ensure that non-impervious clothing which becomes wet with liquid diacetone alcohol be removed promptly and not reworn until the diacetone alcohol is removed from the clothing.
- (iii) Employers shall ensure that clothing wet with liquid diacetone alcohol is placed in closed containers for storage

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

until it can be discarded or until the employer provides for the removal of diacetone alcohol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the diacetone alcohol, the employer shall inform the person performing the operation of the hazardous properties of diacetone alcohol.

(2) Eye Contact

- (i) Employers shall provide, and require employees to use, splash-proof safety goggles (cup-cover type dust and splash safety goggles), which comply with section 1910.133(a)(6), where eye contact to liquid diacetone alcohol may occur.

(h) Spills

- (1) Spills of diacetone alcohol shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.

- (2) Liquid diacetone alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(i) Sanitation

- (1) Employers shall ensure that employees whose skin becomes wet with liquid diacetone alcohol promptly wash or shower as necessary to remove any diacetone alcohol from the skin.

(j) Training and Information - Each employer who has employees exposed to diacetone alcohol in excess of the action level, or employees who may have skin or eye contact with liquid diacetone alcohol, or employees who work where accidental release, spill, fire, or explosion of diacetone alcohol may occur, shall annually:

- (1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for diacetone alcohol, which is contained in Appendix A; and

(2) Medical -

- (I) Advise employees as to the signs and symptoms of exposure to diacetone alcohol.
- (II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to diacetone alcohol which are listed in Appendix A.
- (III) Instruct the employees to inform the employer if they develop any of the medical conditions listed in (k)(2) of this section; and

(3) Procedures -

- (I) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to diacetone alcohol.
- (II) The procedures required by (j)(1), (2), and (3)(I) shall be provided to employees at the expense of the employer during the employee's normal working hours.

-(k) Medical Surveillance

- (1) The employer shall provide medical procedures as required by paragraph (k). These procedures shall be provided at no cost to the employee.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

- (2) Preplacement Questionnaire - The employer shall obtain from each employee who will be exposed to liquid diacetone alcohol, or airborne concentrations of diacetone alcohol at or above the action level, a written statement as to whether such employee has a history of any of the following:
 - (I) Chronic lung disease
 - (II) Skin disease
 - (III) Liver disease
 - (IV) Kidney disease
 - (V) Eye disease
- (3) Preplacement Medical Examination - The employer shall provide a medical examination for an employee if the employee provides a history of any of the conditions named in paragraph (k)(2).
- (4) Results of Preplacement Examination - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(3).
- (5) Periodic Medical Examinations - The employer shall provide a medical examination for an employee if the employee advises the employer of the development of:
 - (I) Any of the medical conditions listed in (k)(2)
 - (II) Signs and symptoms listed in Appendix A which the employee suspects may be caused by exposure to diacetone alcohol.
- (6) Results of Periodic Examinations - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(5).
- (7) Exclusion or Removal from Exposure - No employee shall continue to be exposed to diacetone alcohol if such exposure could place the employee at increased risk of material impairment of his health.
- (8) Emergency Procedures - The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to diacetone alcohol.
- (9) Informing the Physician - The employer shall provide to the examining physician the following information:
 - (I) A copy of this section with its Appendices A, B and C for diacetone alcohol;
 - (II) A description of the employee's duties as they relate to his exposure to diacetone alcohol;
 - (III) A description of any personal protective equipment, including respirators, required to be used;
 - (IV) The results of any employee's exposure measurement, if available;

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

- (V) The employee's anticipated exposure level; and
- (VI) Upon request of the physician, information from previous medical examination of the employee.

(10) Physician's Written Opinion

- (I) The physician's written opinion shall be a signed statement by the examining physician specifically stating:
 - (A) Whether the employee has any detected medical conditions which could be directly or indirectly aggravated by exposure to diacetone alcohol or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.
 - (B) Any recommended limitations upon the employee's exposure to diacetone alcohol.
 - (C) The employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.
- (II) The written opinion shall not reveal medical information unrelated to exposure to diacetone alcohol.

(11) Refusal to be Medically Examined - If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risks involved by refusing to be examined.

(12) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

(1) Recordkeeping.

(1) Initial determination.

- (i) The employer shall keep an accurate record of all initial determinations required to be made pursuant to paragraph (c)(1) of this section.
- (ii) The record shall include the written determination and any supporting documentation as required in paragraph (c)(1) of this section.
- (iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements.

- (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to diacetone alcohol.
- (ii) This record shall include:
 - (a) The date of measurement;

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

- (b) A reference to the subparagraph of this regulation which required the measurement, if any;
 - (c) Operations involving exposure to diacetone alcohol which are being monitored;
 - (d) Sampling and analytical methods used and evidence of their accuracy;
 - (e) Number, duration, and results of samples taken;
 - (f) Name, Social Security number, and exposure of the employee monitored.
 - (iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.
- (3) Mechanical ventilation.
- (i) When mechanical ventilation is used as an engineering control, the employer shall maintain a record of measurements demonstrating the effectiveness of such ventilation as required by paragraph (e)(1)(i) of this section.
 - (ii) This record shall include:
 - (a) Date of measurement;
 - (b) Type of measurement taken;
 - (c) Result of measurement.
 - (iii) This record shall be maintained for at least one year.
- (4) Training and information.
- (i) The employer shall keep an accurate record of all employee training and advice required by paragraph (j) of this section.
 - (ii) The record shall include:
 - (a) Date of training;
 - (b) Name and Social Security number of employees trained;
 - (c) Substance of training provided.
 - (iii) This record shall be maintained until replaced by a more recent record.
- (5) Medical records.
- (i) The employer shall keep an accurate medical record for each employee.
 - (ii) The record shall include:
 - (a) Physician's written opinion;
 - (b) Preplacement questionnaire;
 - (c) Any employee medical complaints relative to exposure to diac;
 - (d) A signed statement of any refusal to be examined;
 - (e) A copy of information provided to the physician pursuant to paragraph (K)(9)(ii) through (vi) of this section.
 - (iii) This record shall be maintained for the duration of the employment of the affected employee.
- (6) Access to records.
- (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary and the Director.
 - (ii) Employee exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(m) Observation of monitoring.

(1) Duty.

The employer shall give affected employees or their representatives an opportunity to observe any monitoring of employee exposure to diacetone alcohol which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to diacetone alcohol requires entry into an area where the use of personal protective devices is required, the observer shall use such equipment and comply with all other applicable safety procedures.

(ii) Without interfering with the measurement, observers shall be entitled to:

(a) Receive an explanation of the measurement procedures;

(b) Visually observe all steps related to the measurement of exposure to diacetone alcohol that are being performed at the place of exposure.

(c) Record the results obtained.

(n) Employee notification.

(1) The employer shall notify in writing, within five work days, every employee who is found to be exposed to diacetone alcohol above the permissible exposure. The employee shall also be notified of the level of his exposure and the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(2) Pursuant to paragraph (k) of this Section, when an employee is medically examined the employer shall provide the employee with a copy of the physician's written opinion.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: Diacetone alcohol

PERMISSIBLE EXPOSURE: 50 parts of diacetone alcohol vapor per million parts of air (ppm) or 240 milligrams of diacetone alcohol vapor per cubic meter of air (mg/cu m)

APPEARANCE AND ODOR: Colorless liquid with a mild odor

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Diacetone alcohol can affect your body if it is swallowed, inhaled, or if it comes in contact with your skin or eyes.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to diacetone alcohol may cause irritation and damage to the eyes, and irritation of the nose and throat.
2. Long-Term Overexposure: Repeated exposure to diacetone alcohol may cause skin irritation.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with diacetone alcohol exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If diacetone alcohol gets into your eyes, wash the eyes immediately with large amounts of water, 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.

B. Skin Exposure: If a large amount of diacetone alcohol gets on your skin flush the contaminated skin with water promptly. If diacetone alcohol soaks through your clothing remove the clothing promptly and flush the skin with water. Do not rewear the clothing until the diacetone alcohol has been removed. Replace impervious clothing that has developed leaks. If there is skin irritation get medical attention.

C. Breathing: If you or any other person breathes in large amounts of diacetone alcohol remove the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

affected person warm and at rest. Get medical attention as soon as possible.

- D. Swallowing: When diacetone alcohol has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.
- E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. RESPIRATORS: Respirators are not the best way to control exposure to diacetone alcohol. You can only be required to wear them for routine use if your employer is in the process of installing controls or other control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA)/National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) If you can smell diacetone alcohol while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shields, and other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid diacetone alcohol.
- C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) if liquid diacetone alcohol may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Diacetone alcohol is a combustible liquid and its vapors can form explosive mixtures with air at elevated temperatures. It must be stored in tightly closed containers in a cool, well-ventilated area away from heat, sparks, flames, strong oxidizers and strong alkalies. Sources of ignition such as smoking and open flames are prohibited wherever diacetone alcohol is handled, used or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of diacetone alcohol, and containers must be bonded and grounded when pouring or transferring liquid diacetone alcohol. If your skin becomes wet with liquid diacetone alcohol, you must promptly wash or shower as necessary to remove the diacetone alcohol from your skin. You must promptly remove any non-impervious clothing that becomes wet with liquid diacetone alcohol and this clothing must not be reworn until the diacetone alcohol is removed from the clothing. If you handle liquid diacetone alcohol, you must wash your hands thoroughly with soap or mild detergent and water before

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

eating, smoking or using toilet facilities. Fire extinguishers and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where diacetone alcohol is used in your work area and for any additional plant safety and health rules.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
DIACETONE ALCOHOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Diacetone; 4-hydroxy-4-methyl-2-pentanone; 2-methyl-2pentanol-4-one
2. Formula: $(CH_3)_2C(OH)CH_2COCH_3$
3. Molecular weight: 116

B. Physical Data

1. Boiling point (760 mm Hg): 164.4 C (328 F)
2. Specific gravity (water=1): 0.94
3. Vapor density (air=1 at boiling point of diacetone alcohol): 4.0
4. Melting point: -43 C (-45 F)
5. Vapor pressure at 20 C (68 F): 0.8 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): 0.14
8. Appearance and odor: Colorless liquid with a mild odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 57.8 C (136 F) (closed cup)
2. Autoignition temperature: 604 C (1118 F)
3. Flammable limits in air, % by volume: Lower: 1.8; Upper: 6.9
4. Extinguishing media: Alcohol foam, dry chemical, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Diacetone alcohol is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where diacetone alcohol is used, handled or stored. Diacetone alcohol vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at locations remote from the site at which diacetone alcohol is handled.
7. For purposes of complying with the requirements of 29 CFR 1910.106, diacetone alcohol is classified as a Class II combustible liquid. At 4500 ppm, one-fourth of the lower

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

flammable limit, diacetone alcohol is considered to be a potential fire and explosion hazard.

8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for diacetone alcohol shall be Class I Group D.

B. Reactivity

1. Conditions contributing to instability: heat
2. Incompatibilities: Contact with strong oxidizers may cause fire and explosion. Contact with strong alkalis may cause formation of flammable acetone vapors.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving diacetone alcohol.
4. Special precautions: Diacetone alcohol will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. 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, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Diacetone alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

- C. Waste disposal methods:

Diacetone alcohol may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary landfill.
2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

- a. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

analyses or dosimeters. The method of measurement must determine the concentration of diacetone alcohol to plus or minus 35%.

- b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of diacetone alcohol to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. Store diacetone alcohol in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to diacetone alcohol can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal diacetone alcohol containers. These containers must be effectively grounded and bonded prior to pouring.
- D. Employers must advise employees of all plant areas and operations where exposure to diacetone alcohol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to diacetone alcohol is likely to occur are: in the application of nitrocellulose lacquers, paper and textile coatings, nongrain stains and wood preservatives, and quick drying inks containing diacetone alcohol; its use as a solvent for cellulose esters, resins, oils, fats, hydrocarbons, gums, dyes, dopes, tars, cements and waxes; and in the manufacture of artificial silk and leather, quick drying inks, photographic film, anti-freeze, and castor-oil-base hydraulic brake fluids.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; minor skin absorption.

II. TOXICOLOGY

The vapor of diacetone alcohol is primarily an irritant and a narcotic. At 100 ppm for 15 minutes there was irritation of the eyes, nose and throat in volunteers. At 400 ppm there was in addition, some chest discomfort. Animals exposed to 2100 ppm developed restlessness, excitement, irritation of the upper respiratory tract and somnolence. There was kidney injury in rabbits after the intramuscular injection of large doses. There was liver injury and anemia in rats after the administration of 2 m.l. per kilogram by stomach tube. No acute or chronic systemic effects in humans have been reported, although the liquid defats the skin and may produce dermatitis upon prolonged or frequently occurring contacts.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, nose and throat. Possible tissue damage of the cornea. May be narcotic at high levels of exposure.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Give artificial resuscitation if indicated. Wash eyes and contaminated skin with water. If swallowed and the person is conscious, induce vomiting. Recovery is usually complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of diacetone alcohol are caused by its irritant properties. It is important that the physician becomes familiar with plant operating conditions in which exposure to diacetone alcohol occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. REPLACEMENT

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

Routine medical histories and physical examination are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

1. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the inhalation of diacetone alcohol might cause exacerbation of symptoms due to its irritant properties.
2. Skin disease -- Diacetone alcohol is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.
3. Liver disease -- Although diacetone alcohol 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.
4. Kidney disease -- Although diacetone alcohol 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 impaired renal function.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above-listed conditions, he must refer such employee for further medical examination.

References

1. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 389-392.
2. American Conference of Governmental Industrial Hygienists: "Diacetone Alcohol," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 70.
3. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1470-1472, and 1750-1753.
4. Hygienic Guide Series: "Diacetone Alcohol," Industrial Hygiene Journal, 17:153-154, 1956.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

REFERENCES AND SOURCES
DIACETONE ALCOHOL
1910.93

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye"
Skin: "Diacetone Alcohol," Union Carbide Corp. Toxicology Study;
Patty, "Industrial Hygiene and Toxicology"
Ingestion: "Diacetone Alcohol," Union Carbide Corp. Toxicology Study;
Patty, "Industrial Hygiene and Toxicology;" "Documentation
of Threshold Limit Values"

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

Grant reports that "tested by dropping on rabbit eyes, it causes moderate temporary injury similar to that caused by acetone, graded 5 on a scale of 1 to 10 after 24 hours." Patty states, "the liquid when in contact with the eyes may cause moderate to marked irritation . . . and transient corneal damage."

A classification of 2 is concluded to be appropriate.

Skin - Classification: 2

Output statement numbers: 2, 7b, 16g, 16i

Exceptions: None

Union Carbide reports "the undiluted chemical caused no reaction on the tender skin of the rabbit belly greater than a faint redness of short duration," and lists a rabbit single skin penetration LD50 of 14.5 ml/kg. Patty gives the same LD50 and adds "diacetone alcohol is not highly irritating to the skin. However, it has been reported to be capable of causing dermatitis upon prolonged or frequently repeated contact."

The vapor pressure of diacetone alcohol is 0.8 mm Hg at 20 degrees C. It is miscible in all proportions with water and has a flash point of 136 degrees F.

A classification of 2 is concluded to be appropriate.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

Patty gives an acute oral rat LD50 of 4.0 gm/kg. Patty adds that "a dosage level of 0.01 g/kg/day . . . administered in the drinking water of rats over a period of 30 days was the maximum level not causing any effect; organic injury occurred when the dose was 0.04 g/kg. Flury and Klimmer noted that in rabbits, 2 ml given 12 times daily caused moderate narcosis, injury to kidneys, and death in three-fourths of the rabbits treated." The Documentation of TLV's states "work, based largely on animal experimentation, would indicate that diacetone alcohol is about twice as toxic systemically as acetone and that it may cause injury to the kidney, liver and blood."

The animal data given in Patty, when extrapolated to humans, indicate that 0.6 ml ingested daily would not have an effect while 2.5 ml/day would cause organic injury. In the context of this standard, it is concluded that ingestion would

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

not present a hazard in the industrial environment.

SUBSTANCE TECHNICAL GUIDELINES
DIACETONE ALCOHOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Diacetone; 4-hydroxy-4-methyl-2-pentanone; 2-methyl-2-pentanol-4-one
2. Formula: $(CH_3)_2C(OH)CH_2COCH_3$
3. Molecular weight: 116

B. Physical Data

1. Boiling point (760 mm Hg): 164.4 C (328 F)
2. Specific gravity (water=1): 0.94
3. Vapor density (air=1 at boiling point of diacetone alcohol): 4.0
4. Melting point: -43 C (-45 F)
5. Vapor pressure at 20 C (68 F): 0.8 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate=1): 0.14
8. Appearance and odor: Colorless liquid with a mild odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 57.8 C (136 F) (closed cup)
2. Autoignition temperature: 604 C (1118 F)
3. Flammable limits in air, % by volume: Lower: 1.8; Upper: 6.9
4. Extinguishing media: Alcohol foam, dry chemical, carbon dioxide
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: Diacetone alcohol is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where diacetone alcohol is used, handled or stored in a manner that could create a potential fire or explosion hazard. Diacetone alcohol vapors are heavier than air and may travel along the ground and be ignited by sparks or open flames at locations remote from the site at which diacetone alcohol is handled.
7. For purposes of complying with the requirements of 29 CFR 1910.106, diacetone alcohol is classified as a Class II combustible liquid. For example, 4500 ppm, approximately one-fourth of the lower flammable limit, is one situation in which diacetone alcohol is considered to be a potential fire and explosion hazard.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for diacetone alcohol shall be Class I Group D.

B. Reactivity

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact with strong oxidizers may cause fire and explosion. Contact with strong alkalies may cause formation of flammable acetone vapors.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving diacetone alcohol.
4. Special precautions: Diacetone alcohol will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. 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, absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Diacetone alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: Diacetone alcohol 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.

IV. MONITORING AND MEASUREMENT PROCEDURES

- a. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of diacetone alcohol to plus or minus 35%.
- b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of diacetone alcohol to plus or

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. Store diacetone alcohol in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to diacetone alcohol can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal diacetone alcohol containers. These containers must be effectively grounded and bonded prior to pouring.
- D. Employers should advise employees of all plant areas and operations where exposure to diacetone alcohol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to diacetone alcohol is likely to occur are: in the application of nitrocellulose lacquers, paper and textile coatings, nongrain stains and wood preservatives, and quick drying inks containing diacetone alcohol; its use as a solvent for cellulose esters, resins, oils, fats, hydrocarbons, gums, dyes, dopes, tars, cements and waxes; and in the manufacture of artificial silk and leather, quick drying inks, photographic film, anti-freeze, and castor-oil-base hydraulic brake fluids.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Diacetone alcohol

D.O.L. STANDARD: 50 ppm

WARNING PROPERTIES:

Odor Threshold: Patty reports that an objectionable odor occurs at 100 ppm diacetone alcohol.

Irritation Levels: Patty reports that "Silverman, Schulte, and First in stud with humans found that 100 ppm of diacetone alcohol caused definitive eye irritation. This level was also reported to cause a definite bad taste.

Evaluation of Warning Properties: Through its odor, taste, and irritation, diacetone alcohol can be detected at a concentration only 2 times the pe exposure limit. For the purposes of this standard, therefore, gas sorbe respiratory equipment is permitted, since this compound has good warning properties.

IDLH: 2100 ppm

Basis for IDLH Value: The only acute inhalation toxicity information availab upon which to base an IDLH concentration for diacetone alcohol is the re that animals exposed "for 1 to 3 hours to 2100 ppm exhibited restlessness irritation of the membranes, excitement, and later somnolence." The chosen IDLH is obviously conservative.

Other Toxicological Information: Patty states that: "According to Smyth and Carpenter rats survived an 8-hour exposure to an atmosphere saturated wi the vapors of diacetone alcohol. It is reported that mice, rats, rabbit exposed for 1 to 3 hours to 2100 ppm exhibited restlessness, irritation the membranes, excitement, and later somnolence. In view of the vapor p of acetone alcohol at ordinary room temperatures, information regarding the conditions under which the concentration of 2100 ppm was achieved wo helpful in evaluating the significance of these observations."

The Documentation of TLV's states that "in view of eye, nose, and irritation occurring in persons exposed at 100 ppm, a value of 50 ppm is for diacetone alcohol."

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

LFL: 18,000 ppm

VAPOR PRESSURE AT 20 C: 0.8 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 1050 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

USE/EXPOSURE AND CONTROL DOCUMENT
DIACETONE ALCOHOL

Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapors and skin and eye contact with liquid during the application of nitrocellulose lacquers	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol.
2. Inhalation of vapors and skin and eye contact with liquid during use as a solvent for cellulose esters, epoxy resins, hydrocarbons, oils, fats, resins, gums, dyes, dopes, tars, cements and waxes	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol.
3. Inhalation of vapors and skin and eye contact with liquid during application of paper and textile coatings containing diacetone alcohol	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol.
4. Inhalation of vapors and skin and eye contact with liquid during the application of nongrain stains and wood preservatives containing diacetone alcohol	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol.
5. Inhalation of vapors and skin and eye contact with the liquid in the manufacture of artificial silk and leather	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol.
6. Inhalation of vapors and skin and eye contact with the liquid during the use of quick drying inks	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol.
7. Inhalation of vapors and skin and eye contact with the liquid during the manufacture of quick	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for DIACETONE ALCOHOL

drying inks

gloves, goggles). By analogy with n-butanol.

- | | | | |
|-----|--|-----|---|
| 8. | Inhalation of vapors and skin and eye contact with liquid during the use as a pigment solvent in the dyeing industry | A,B | Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol. |
| 9. | Inhalation of vapors and skin and eye contact during the manufacture of photographic film | A,B | Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol. |
| 10. | Inhalation of vapors and skin and eye contact with liquid during the manufacture of some anti-freeze preparations | A,B | Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol. |
| 11. | Inhalation of vapors and skin and eye contact with liquid during the manufacture of castor-oil-base hydraulic brake fluids | A,B | Local exhaust ventilation; general dilution ventilation; personal protective equipment (impervious gloves, goggles). By analogy with n-butanol. |

A -- Inhalation

B -- Skin contact resulting in localized irritation

C -- Ingestion

D -- Skin contact resulting in absorption and subsequent systemic poisoning