

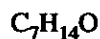
OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR DIPROPYL KETONE

INTRODUCTION

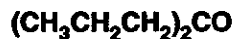
This guideline summarizes pertinent information about dipropyl ketone for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether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



- **Structure**



- **Synonyms**

4-Heptanone; DPK; butyrone; GBL; Heptan-4-one; propyl ketone

- **Identifiers**

1. CAS No.: 123-19-3
2. RTECS No.: MJ5600000
3. DOT UN: 2710 26

4. DOT label: Flammable liquid

- **Appearance and odor**

Dipropyl ketone is a combustible, colorless liquid with a pleasant but penetrating odor and a burning taste.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 114.2
2. Boiling point (760 mm Hg): 144°C (291°F)
3. Specific gravity (water = 1): 0.82 at 15°C (59°F)
4. Vapor density (air = 1 at boiling point of dipropyl ketone): 3.9
5. Melting point: -32.6°C (-26.7°F)
6. Vapor pressure at 20°C (68°F): 5.2 mm Hg
7. Solubility: Insoluble in water; miscible with alcohol and ether.
8. Evaporation rate: Data not available.

- **Reactivity**

1. Conditions contributing to instability: Heat and open flame
2. Incompatibilities: Contact of dipropyl ketone with oxidizing agents may cause a violent reaction.

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

4. Special precautions: None reported

- **Flammability**

The National Fire Protection Association has assigned a flammability rating of 2 (moderate fire hazard) to dipropyl ketone.

1. Flash point: 49°C (120°F) (closed cup)

2. Autoignition temperature: Data not available

3. Flammable limits in air: Data not available

4. Extinguishant: Use dry chemical, carbon dioxide, water spray, or alcohol-resistant foam to fight fires involving dipropyl ketone. Water may be ineffective, but it may be used to cool fire-exposed containers.

Fires involving dipropyl ketone should be fought upwind 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 dipropyl ketone 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 is 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 a mile in all directions. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving dipropyl ketone. Structural firefighters' protective clothing may provide limited protection against fires involving dipropyl ketone.

EXPOSURE LIMITS

- **OSHA PEL**

The Occupational Safety and Health Administration

(OSHA) has not promulgated a permissible exposure limit (PEL) for dipropyl ketone [29 CFR 1910.1000, Table Z-1].

- **NIOSH REL**

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 50 ppm (235 mg/m³) as a TWA for up to a 10-hr workday and a 40-hr workweek for dipropyl ketone [NIOSH 1992].

- **ACGIH TLV**

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned dipropyl ketone a threshold limit value (TLV) of 50 ppm (233 mg/m³) as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1993].

- **Rationale for limits**

The NIOSH limit is based on mild toxicity and liver effects in animals caused by exposure to high concentrations of dipropyl ketone [NIOSH 1992].

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Exposure to dipropyl ketone can occur through inhalation, ingestion, and eye or skin contact.

- **Summary of toxicology**

1. *Effects on Animals:* Dipropyl ketone is a mild irritant of the eyes and skin and, at high concentrations, a narcotic in animals. Applied to the eyes of rabbits, dipropyl ketone produced mild irritation [NIOSH 1994]. A single application of this substance to the skin of guinea pigs caused slight irritation, but repeated applications of 0.5 ml over a 10-day period caused more serious inflammation [Clayton and Clayton 1982]. In rabbits, the dermal LD₅₀ is 5,660 mg/kg [NIOSH 1994]. Fifty percent of rats inhaling a 2,690-ppm concentration of dipropyl ketone for 6 hours (LC₅₀) died; before death, these animals exhibited somnolence and respiratory depression [NIOSH 1994; Clayton and Clayton 1982]. Rats exposed to a dipropyl ketone concentration of 400 ppm for 6 hours showed signs of respiratory depression, and those exposed to 1,600 ppm for the same period became

narcotic [Clayton and Clayton 1982]. The oral LD₅₀ in rats is 3,730 mg/kg [NIOSH 1994]. Rats exposed for 6 hours/day, 5 days/week for 2 weeks to a 1,200-ppm dipropyl ketone atmosphere had slightly enlarged livers, although no changes in hematology or serum chemistry were seen [Clayton and Clayton 1982]. Rats gavaged with 2,000 mg/kg dipropyl ketone for 5 days/week for 12 weeks showed signs of severe central nervous system depression and had a reduced rate of weight gain; when the dose was lowered to 1,000 mg/kg, weight gain improved and no clinical abnormalities were seen. At autopsy, however, animals in both dose groups had increased liver and kidney weights and showed hepatocyte hypertrophy [Clayton and Clayton 1982].

2. *Effects on Humans:* Contact of the skin or eyes with the liquid or vapor causes skin or eye irritation [Clayton and Clayton 1982]. Based on effects seen in animals, acute exposure to dipropyl ketone may cause central nervous system depression in humans, and chronic exposure could lead to liver damage [Clayton and Clayton 1982].

• Signs and symptoms of exposure

1. *Acute exposure:* The signs and symptoms of acute exposure to dipropyl ketone include redness and inflammation of the eyes and eyelids, coughing and sneezing, and redness and inflammation of the skin. At higher concentrations, dizziness, sleepiness, slowed breathing, and unconsciousness may occur.

2. *Chronic exposure:* Based on effects seen in animals, the signs and symptoms of chronic exposure to dipropyl ketone may include enlargement of the liver, with jaundice and elevated liver enzymes, and kidney damage, with elevated urinary protein or creatinine levels and blood or pus in the urine. Dryness and cracking of the skin may occur on prolonged or repeated contact.

• Emergency procedures

WARNING!

Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of toxicity or irritation!

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

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

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

3. *Inhalation exposure:* 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 dipropyl ketone or any material 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 dipropyl ketone and lead to worker exposures to this substance:

—Use as a solvent for nitrocellulose, raw and blown oils, resins, and polymers

—Use in food flavorings and in lacquer formulations

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

- Process enclosure
- Local exhaust ventilation
- General dilution ventilation
- Personal protective equipment

Good sources of information on control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 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, 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) period-

ically 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 dipropyl ketone, 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, mucous membranes, skin, and central nervous system.

A preplacement medical evaluation is recommended to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to dipropyl ketone 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 diseases of the eyes, mucous membranes, skin, or central nervous system.

• 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 dipropyl ketone exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of dipropyl ketone on the eyes, mucous membranes, skin, and central nervous system. 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 tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for dipropyl ketone.

- **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 placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

Determination of a worker's exposure to airborne dipropyl ketone is made using a Carbosieve S-III tube (130/65 mg sections; 60/80 mesh). Samples are collected at a maximum flow rate of 0.05 liter/min until a maximum air volume of 3 liters is collected. The sample is then treated with a carbon disulfide/dimethylformamide mixture (99:1) to extract the dipropyl ketone. Analysis is conducted by gas chromatography using a flame ionization detector. This method is included in the OSHA Laboratory In-House Methods File [OSHA 1989].

PERSONAL HYGIENE

If dipropyl ketone contacts the skin, workers should wash the affected areas with soap and water.

Clothing contaminated with dipropyl ketone should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of dipropyl ketone, particularly its potential to cause skin irritation.

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

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

STORAGE

Dipropyl ketone 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]. Containers of dipropyl ketone should be protected from physical damage and should be stored separately from oxidizing agents, reducing agents, bases, heat, sparks, and open flame. Only nonsparking tools may be used to handle dipropyl ketone. Because containers that formerly contained dipropyl ketone may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving dipropyl ketone, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. 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. Ventilate the area of the spill or leak.
5. Water spray may be used to reduce vapors, but the spray may not prevent ignition in closed spaces.
6. For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal.
7. For large liquid spills, build dikes far ahead of the spill to contain the dipropyl ketone 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

Dipropyl ketone 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

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of dipropyl ketone; there is no reportable quantity for this substance.

Community right-to-know requirements

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of dipropyl ketone 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. Although dipropyl ketone is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat any waste as hazardous if it exhibits any of the characteristics discussed above.

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 this substance 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 dipropyl ketone 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, respirator 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 about the selection and use of respirators and about 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

Protective clothing should be worn to prevent prolonged or repeated skin contact with dipropyl ketone. 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. No reports have been published on the resistance of various protective clothing materials to dipropyl ketone permeation. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to dipropyl ketone.

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

Safety glasses, goggles, or face shields should be worn during operations in which dipropyl ketone might contact the eyes (e.g., through splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with dipropyl ketone. Contact lenses should not be worn if the potential exists for dipropyl ketone exposure.

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