

Diethyl ether

Properties

emolecules VID



Reaxys Registry Number

[1696894](#)

CAS Numbers

60-29-7; 60-29-7; 60-29-7; 60-29-7

Synonyms

: Ether; Ethyl ether; Diethyl oxide; Ethyl oxide; Sulfuric ether; Anesthetic ether; Ethoxyethane; DIETHYL ETHER; ether; Aether; Anaesthetic ether; Anesthesia ether; Diaethylaether (German); Eter etílico (Spanish); Ethane, 1,1'-oxybis-; Ether, ethyl; Ether ethylique (French); Oxyde d'éthyle (French); Solvent ether

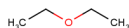
Molecular Formulas

CH₃CH₂OCH₂CH₃; C₂H₅OC₂H₅; EtOEt; C₄H₁₀O

Molecular Weight

74.1228

Structure



RTECS

KI5775000

EEC

200-467-2

Brief Description

Ethyl ether is a colorless, mobile, highly flammable, volatile liquid with a characteristic pungent odor. The Odor Threshold is 0.63 ppm. Slightly soluble in water.

Inchi

RTZKZFJDLAIYFH-UHFFFAOYAB

UN ID Number

UN1155

DOT Class

Class 3, Flammable and combustible liquid

NFPA Class

IA

Regulatory Authority and Advisory Bodies

U.S. EPA Gene-Tox Program, Positive: E coli polA without S9; Negative: Aspergillus-forward mutation; Sperm morphology-mouse; Inconclusive: Histidine reversion-Ames test

Air Pollutant Standard Set. See Occupational Exposure Guidelines.

Clean Air Act: Accidental Release Prevention/Flammable Substances, (Section 112 [r], Table 3), TQ = 10,000 lb (4540 kg)

U.S. EPA Hazardous Waste Number (RCRA No.): U117

RCRA, 40CFR261, appendix 8 Hazardous Constituents

Superfund/EPCRA 40CFR302.4 Reportable Quantity (RQ): CERCLA, 100 lb (45.4 kg)

RCRA 40CFR268.48; 61FR15654, Universal Treatment Standards: Wastewater (mg/L), 0.12; Nonwastewater (mg/kg), 160

Canada, WHMIS, Ingredients Disclosure List Concentration 1%

Cited State Regulations

Alaska (G), California (A,G), Connecticut (A), Florida (A,G), Illinois (G), Kansas (G), Louisiana (G), Maine (G), Massachusetts (A,G), Nevada (A), New Hampshire (G), New Jersey (G), New York (A), North Dakota (A), Pennsylvania (G), Rhode Island (G), Vermont (G), Virginia (A,G), Washington (G), West Virginia (G), Wisconsin (G).

Melting Point

-116 °C (-177 °F)

Boiling Point

34.4 °C (94 °F)

Autoignition Temperature

180 °C (356 °F)

Flashpoint

-45 °C (-49 °F)

Flammability Limits

lower = 1.9%; upper = 36%

Solubility in Water

7%

Specific Gravity

0.71

Vapor/Gas Density

2.62 (air = 1)

Vapor Pressure

440 mm Hg @ 20 °C

Handling

Occupational PPE Recommendations

Wear protective gloves and clothing to prevent any reasonable probability of skin contact. Safety equipment suppliers/manufacturers can provide recommendations on the most protective glove/clothing material for your operation. **8 hr:** polyvinyl alcohol gloves; 4H™ and Silver Shield™ gloves; Barricade® coated suits; **4 hr:** Teflon™ gloves, suits, boots; Responder™ suits, Trelchem HPS™ suits. All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work. Contact lenses should not be worn when working with this chemical. Wear splash-proof chemical goggles and face shield unless full face-piece respiratory protection is worn. Employees should wash immediately with soap when skin is wet or contaminated. Provide emergency showers and eyewash.

PRACTICAL TIP



Flammable liquid. Containers that have been opened may contain dangerous explosive peroxides. May accumulate static electricity. Low ignition energy. Slight health hazard

Emergency PPE Recommendations	Wear full protective clothing and positive pressure self-contained breathing apparatus.
Spill Response Recommendations	Evacuate and restrict persons not wearing protective equipment from area of spill or leak until cleanup is complete. Remove all ignition sources. Establish forced ventilation to keep levels below explosive limit. Absorb liquids in vermiculite, dry sand; earth, peat, carbon, or a similar material and deposit in sealed containers. Keep diDiethyl ether out of a confined space, such as a sewer, because of the possibility of an explosion, unless the sewer is designed to prevent the build-up of explosive concentrations. It may be necessary to contain and dispose of this chemical as a hazardous waste. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Contact your Department of Environmental Protection or your regional office of the federal EPA for specific recommendations. If employees are required to clean-up spills, they must be properly trained and equipped. OSHA 1910.120(q) may be applicable.
Storage Recommendations	Prior to working with this chemical you should be trained on its proper handling and storage. Before entering confined space where this chemical may be present, check to make sure that an explosive concentration does not exist. Diethyl ether must be stored to avoid contact with strong oxidizers (such as bromine, chlorine, chlorine dioxide, and nitrates), since violent reactions occur. Store in tightly closed containers in a cool, dry, well-ventilated area away from heat and sunlight. Unstable peroxides may form if diDiethyl ether is exposed for a long time to air or sunlight, causing explosions. Sources of ignition, such as smoking and open flames are prohibited where Diethyl ether is handled, used, or stored. Metal containers involving the transfer of 5 gallons or more of Diethyl ether should be grounded and bonded. Drums must be equipped with self-closing valves, pressure vacuum bungs; and flame arresters. Use only non-sparking tools and equipment, especially when opening and closing containers of Diethyl ether. Wherever Diethyl ether is used, handled, manufactured, or stored, use explosion-proof electrical equipment and fittings.
Disposal Suggestions	Concentrated waste containing no peroxides - discharge liquid at a controlled rate near a pilot flame. Concentrated waste containing peroxides - perforation of a container of the waste from a safe distance followed by open burning [IRPTC (1985) a] Consult with environmental regulatory agencies for guidance on acceptable disposal practices. Generators of waste containing this contaminant (= >100 kg/mo) must conform with EPA regulations governing storage, transportation, treatment, and waste disposal.
HazMat Shipping Label	This compound requires a shipping label of "FLAMMABLE LIQUID." Quantity limitations: Passenger aircraft/rail: 1 L; Cargo aircraft only: 30 L. It falls in DOT Hazard Class 3 and Packing Group I.

Safety

Common Uses	Ethyl ether is used as a solvent for waxes, fats, oils, perfumes, alkaloids, dyes, gums, resins, nitrocellulose, hydrocarbons; raw rubber; and smokeless powder. It is also used as an inhalation anesthetic; a refrigerant; in diesel fuels; in dry cleaning; as an extractant; and as a chemical reagent for various organic reactions. Ethyl ether is used in the production of rubber, plastics, paints, coatings, perfumes, and cosmetics.
First Aid Recommendations	If this chemical gets into the eyes, remove any contact lenses at once and irrigate immediately for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately. If this chemical contacts the skin, remove contaminated clothing and wash immediately with soap and water. Seek medical attention immediately. If this chemical has been inhaled, remove from exposure, begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped. Transfer promptly to a medical facility. When this chemical has been swallowed, get medical attention. Give large quantities of salt water and induce vomiting. Do not make an unconscious person vomit.
Occupational Exposure Guidelines	<p>OSHA PEL: 400 ppm/1200 mg/m³ TWA</p> <p>NIOSH REL: None. See Appendix D (NIOSH Pocket Guide)</p> <p>ACGIH TLV[®] [ACGIH (2007) a] : 400 TWA; 500 ppm STEL</p> <p>Mine Safety and Health Administration (MSHA): 400 ppm/1200 mg/m³ TWA</p> <p>DFG MAK: 400 ppm/1200 mg/m³ ; Peak Limitation Category I(1); Pregnancy Risk Group D</p> <p>NIOSH IDLH = 1900 ppm [LEL]</p> <p>Australia: TWA 400 ppm (1200 mg/m³); STEL 500 ppm, 1993; Austria: MAK 400 ppm (1200 mg/m³), 1999; Belgium: TWA 400 ppm (1210 mg/m³); STEL 500 ppm, 1993; Denmark: TWA 400 ppm (1200 mg/m³), 1999; Finland: TWA 400 ppm (1200 mg/m³); STEL 500 ppm (1500 mg/m³), 1999; France: VME 400 ppm (1200 mg/m³), VLE 500 ppm (1500 mg/m³), 1999; Hungary: TWA 300 mg/m³ ; STEL 600 mg/m³ [skin] 1993; the Netherlands: MAC-TGG 308 mg/m³ , 2003; Norway: TWA 200 ppm (600 mg/m³), 1999; the Phillipines: TWA 400 ppm (1200 mg/m³), 1993; Poland: MAC (TWA) 300 mg/m³ , MAC (STEL) 1500 mg/m³ , 1999; Russia: TWA 400 ppm; STEL 300 mg/m³ , 1993; Switzerland: MAK-W 400 ppm (1200 mg/m³), KZG-W 800 ppm (2400 mg/m³), 1999; Turkey: TWA 400 ppm (1200 mg/m³), 1993; United Kingdom: TWA 400 ppm (1230 mg/m³); STEL 500 ppm, 2000; Argentina, Bulgaria, Columbia, Jordan, South Korea, New Zealand, Singapore, Vietnam: ACGIH TLV[®] : STEL 500 ppm.</p> <p>The Czech Republic: [US EPA (1987) a c] TWA 500 mg/m³ ; STEL 1500 mg/m³ . Russia [US EPA (1987) a c] set a MAC in the ambient air of residential areas of 1.0 mg/m³ on a once-a-day basis and 0.6 mg/m³ on a daily average basis. Several states have set guidelines or standards for Diethyl ether in ambient air [US EPA (1990) b] ranging from 0.16 mg/m³ (Massachusetts) to 12.0 - 15.0 mg/m³ (North Dakota) to 20.0 mg/m³ (Virginia) to 24.0 mg/m³ (Connecticut, Florida, New York) to 28.571 mg/m³ (Nevada).</p>
Respirator Recommendations	OSHA: 1,900 ppm: CcrOv (APF = 10) [any chemical cartridge respirator with organic vapor cartridge(s)]; or GmFOv (APF = 50) [any air-purifying, full-face-piece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister]; or PaprOv (APF = 25) [any powered, air-purifying respirator with organic vapor cartridge(s)]; or Sa (APF = 10) (any supplied-air respirator); or ScbaF (APF = 50)

(any self-contained breathing apparatus with a full face-piece). *Emergency or planned entry into unknown concentrations or IDLH* and is operated in a pressure-demand or other positive-pressure mode); or SaF: Pd,Pp: AScba (APF = 10,000) (any supplied-air respirator that has a full face-piece and is 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). *Escape*: GmFOv (APF = 50) [any air-purifying, full-face-piece respirator (gas mask) with a chin-style, front-or back-, mounted organic vapor canister]; or ScbaE (any appropriate escape-type, self-contained breathing apparatus).

Note: Substance reported to cause eye irritation or damage; may require eye protection.

Analysis Method - Air	Use NIOSH Analytical Method #1610 or OSHA Analytical Method 7. [NIOSH (2007) a]
Analysis Method - Water	Ecotoxicity: Log K_{ow} = 0.9.

Reactivity

Common Reactive Hazards

Forms explosive mixture with air. Incompatible with strong acids; strong oxidizers halogens, sulfur, sulfur compounds, causing fire and explosion hazard. Can form peroxides from air, heat, sunlight; may explode when container is unstoppered or otherwise opened. Attacks some plastics, rubber and coatings. Being a non-conductor, chemical may accumulate static electric charges that may result in ignition of vapor.

The hydroperoxide initially formed by autoxidation of ether is not particularly explosive, but on standing and evaporation, polymeric 1-oxyperoxides are formed which are dangerously explosive, even below 100 °C [\[Criegee \(1936\) a\]](#). Numerous laboratory explosions have been caused by evaporation of peroxidised ether [\[Criegee \(1958\) a c\]](#). Formation of peroxide in stored ether may be prevented by presence of sodium diethyldithiocarbamate (0.05 ppm), [\[Ray \(1955\) a\]](#), which probably deactivates traces of metals which catalyse peroxidation [\[Criegee \(1958\) a c\]](#); of pyrogallol (1 ppm) [\[Ray \(1955\) a\]](#); or by larger proportions (5 to 20 ppm) of other inhibitors [\[Anon. \(1947\) a\]](#). Once present in ether, peroxides may be detected by the iodine-starch test, and removed by percolation through anion exchanger resin [\[Feinstein \(1959\) a\]](#) or activated alumina [\[Davies \(1956\) a\]](#), which leaves the ether dry, or by shaking with aqueous ferrous sulfate or sodium sulfite solutions. Many other methods have been described [\[Davies \(1956\) a\]](#). A small quantity of ether stored in an unmodified domestic refrigerator in a biochemistry laboratory led to an explosion, with ignition by the thermostat contacts [\[Anon. \(1987\) v\]](#). An explosion attributed to peroxide formation is reported during a laboratory clear-up. It happened a few seconds after antique ether containers, in a fume hood with other materials, were opened; too long for mechanical initiation of peroxide explosion and not long enough for concentration by evaporation of ether. The main injuries were nitric acid burns [\[Ceru \(1995\) b\]](#). (Since clear-ups are a common time for mixing nitric acid with waste solvent, the attribution may be suspect.)

Reactive Hazards with Other Chemicals

Boron triazide

[See: Boron triazide: Diethyl ether, etc.](#)

Halogens, or Interhalogens

[Bromine pentafluoride: Hydrogen-containing materials](#)

[Bromine: Diethyl ether](#)

[Chlorine: Diethyl ether](#)

[Iodine heptafluoride: Organic solvents](#)

[See: Bromine trifluoride: Halogens, etc., or: Solvents](#)

Other reactants

Yoshida, 1980, 140

MRH values calculated for 13 combinations with oxidants are given.

Oxidants

MRH values show % of oxidant

[Chromyl chloride: Organic solvents](#)

["Fluorine nitrate": Organic materials](#)

Hydrogen peroxide: Diethyl ether MRH 6.53/84 [Hydrogen peroxide: Diethyl ether MRH 6.53/84](#)

[Iodine\(VII\) oxide: Diethyl ether](#)

[LIQUID AIR: Diethyl ether](#)

[Lithium perchlorate: Diethyl ether](#)

Nitric acid: Diethyl ether MRH 5.94/79 [Nitric acid: Diethyl ether MRH 5.94/79](#)

[Nitrosyl perchlorate: Organic materials](#)

[Nitryl perchlorate: Organic solvents](#)

[Ozone: Diethyl ether](#)

[Perchloric acid: Diethyl ether](#)

[Permanganic acid: Organic materials](#)

[Peroxodisulfuric acid: Organic liquids](#)

[Silver perchlorate: Diethyl ether](#)

Sodium peroxide: Organic liquids MRH 2.55/92 [Sodium peroxide: Organic liquids MRH 2.55/92](#)

See: Halogens, or Interhalogens, above

Peat soils

Walkley, A., *Austral. Chem. Inst. J.*, 1939, **6**, 310

Explosions occurred during the extraction of fats and waxes from the soils with ether, as well as when heating the extract at 100°C. Although the latter is scarcely surprising (the ether contained 230 ppm of peroxides), the former observation is unusual.

Sulfur, or Sulfur compounds

[Sulfur: Diethyl ether](#)

[Thiotriethiazyl perchlorate: Organic solvents](#)

[See: Sulfonyl chloride: Diethyl ether](#)

Uranyl nitrate

[See: Uranyl nitrate: Diethyl ether](#)

Wood pulp extracts

Durso, D. F., *Chem. Eng. News*, 1957, **35** (34), 91, 115

Ethereal extracts of pulp exploded during or after concentration by evaporation. Although the ether used for the extraction previously had been freed from peroxides by treatment with cerium(III) hydroxide, the ethereal extracts had been stored for 3 weeks before concentration was effected. (During this time the ether and/or extracted terpenes would be expected to again form peroxides, but no attempt seems to have been made to test for, or to remove them before distillation was begun).

[See other: PEROXIDISABLE COMPOUNDS](#)

Related Records

[POLYPEROXIDES](#)
[1-OXYPEROXY COMPOUNDS](#)
[PEROXIDISABLE COMPOUNDS](#)

References

Ceru, B. (1995). *Safe Science*, Michigan State University.
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 Walkley, A. (1939). *Austral. Chem. Inst. J.*, **6**, 310.
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 Criegee, R. et al. (1936). *Angew. Chem.*, **49**, 101.
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 Feinstein, R. N. (1959). *J. Org. Chem.*, **24**, 1172.
 Anon. (1987). *Lab. Accid. in Higher Educ.*, Item 27, HSE, Barking.

Flammability

Fire and Explosion Hazards

Flammable liquid. Vapors are heavier than air and may travel to a source of ignition and flash back. Liquid floats on water and may travel to a source of ignition and spread fire.

Firefighting Procedure

This chemical is an extremely flammable liquid. Poisonous gases are produced in fire. Use dry chemical, carbon dioxide; or alcohol foam extinguishers. Vapors are heavier than air and will collect in low areas. Vapors may travel long distances to ignition sources and flashback. Vapors in confined areas may explode when exposed to fire. Containers may explode in fire. Storage containers and parts of containers may rocket great distances, in many directions. If material or contaminated runoff enters waterways, notify downstream users of potentially contaminated waters. Notify local health and fire officials and pollution control agencies. From a secure, explosion-proof location, use water spray to cool exposed containers. If cooling streams are ineffective (venting sound increases in volume and pitch, tank discolors, or shows any signs of deforming), withdraw immediately to a secure position. If employees are expected to fight fires, they must be trained and equipped in OSHA 1910.156. The only respirators recommended for fire fighting are self-contained breathing apparatuses that have full face-pieces and are operated in a pressure-demand or other positive-pressure mode.

Electrical Equipment

Class I, Group C

Toxicity

Human Acute Toxicity

The target organ of ether is the CNS. Inhalation of high concentrations may cause CNS effects including headache, dizziness, unconsciousness, and coma. It is, however, rare to find death due to an inhalation exposure. Ingestion poisonings are of rapid onset, short duration and clinically similar to ethanol overdose. Diethyl ether is an irritant to the eye, skin, and mucous membranes. Contact with liquid may produce a dry, scaly, fissured dermatitis.

Human Chronic Toxicity

Ethyl ether has predominantly narcotic properties. Overexposed individuals may experience drowsiness, vomiting, and unconsciousness. Death may result from severe overexposure. Chronic exposure results in some persons in anorexia, exhaustion, headache, drowsiness, dizziness, excitation, and psychic disturbances. Albuminuria has been reported. Chronic exposure may cause an increased susceptibility to alcohol. There is an association between exposure to anesthetic vapors and increased miscarriages and birth defects. Diethyl ether's role in these increased risks is unclear. Repeated dermal exposure may cause the skin to become dry and cracked due to oil extraction.

Exposure Standards and Guidelines

Exposure Standards and Guidelines

The Occupational Safety and Health Administration permissible exposure limit is set at 8 h time-weighted average of 400 ppm, which is equivalent to 1200 mg m⁻³. Fifteen minutes short term exposure limit is 500ppm. The 'immediately dangerous to life or health' concentration is 1900 ppm and is based on 10% of the lower explosive limit for safety considerations.

Target Organs

Routes of entry: Inhalation of vapor, ingestion; skin and/or eye contact.

Occupational exposure to diethyl ether may occur through inhalation and dermal contact with this compound at workplaces where diethyl ether is used. Exposure to this chemical may also occur via inhalation of ambient air and ingestion of contaminated drinking water.

Target organs: Central nervous system; skin, respiratory system; eyes.

Reproductive Toxicity	<p><i>In Vitro</i> Toxicity Data</p> <p>Mutagenicity studies in cultured mammalian cells are ambiguous. Positive and negative results have been reported. Bacterial mutagenicity tests have been primarily negative. Aged ether (containing peroxides) has been shown to be mutagenic.</p>
Permissible Concentration in Water	Russia [US EPA (1987) a c] [Lewis (2002) a] has set a MAC in water bodies used for domestic purposes of 0.3 mg/L.
Ecotoxicity	<p>Ecotoxicology</p> <p>The LC₅₀ for <i>Poecilia reticulata</i> (guppy) is shown to be 2138ppm for 14 days. The LC₅₀ for <i>Pimephales promelas</i> (fathead minnow) is 2560mg l⁻¹ for 96h.</p>
Environmental Fate/Stability	<p>Environmental Fate</p> <p>The industrial use of diethyl ether may result in its release to the environment through various waste streams. In air, diethyl ether will exist as a vapor and will be degraded in the atmosphere after reacting with hydroxyl and nitrate radicals. Half-lives of these reactions in air are estimated to be 1.2 and 5.8 days, respectively. In soil and water, diethyl ether is expected to volatilize and biodegradation is likely to be a slow process. Bioconcentration of diethyl ether in aquatic organisms is low.</p>
Clinical Management Information	<p>Clinical Management</p> <p>Contact with the skin should be minimized by thoroughly washing affected areas for at least 15 min. Symptoms of dermatitis should be treated if necessary. If ingested, vomiting should not be induced since ether poses an aspiration hazard and chemical pneumonitis may occur. CNS depression may result from ingestion. Treatment should be symptomatic. There are no known antidotes to diethyl ether.</p>
Medical Surveillance	<p>Preplacement or periodic examinations should evaluate the skin and respiratory tract; liver, and kidney function. Persons with a past history of alcoholism may be at some increased risk due to possibility of Diethyl ether addiction (known as "ether habit"). Tests for exposure may include expired breath for unmetabolized Diethyl ether and blood for Diethyl ether content by oxidation with chromate solution or by gas chromatographic methods. NIOSH lists the following tests: whole blood (chemical/metabolite), expired air, urine (chemical/metabolite).</p>
Mechanism of Toxicity Action	<p>The mechanism and site of action of diethyl ether are unknown. In the past, most solvents were thought to interfere with the bulk properties of membranes such as membrane fluidity and permeability, thus causing a generalized perturbation to neuronal membranes. In recent years, it has emerged that specific sites such as ion channels and other receptors are the more likely targets.</p> <p>Toxicokinetics</p> <p>Diethyl ether is immediately absorbed from inhaled air into the bloodstream and passes rapidly into the brain. More than 80% will be eliminated through the lungs and another 1-2% excreted in the urine. The remainder may deposit in fatty tissue. Radiotracer studies in rats have shown that diethyl ether can be degraded to carbon dioxide. 90% of diethyl ether applied on skin is absorbed after 20 min.</p>
Animal Chronic Toxicity	Rats exposed orally to 3500 mg kg ⁻¹ day ⁻¹ for 13weeks to diethyl ether presented signs of toxicity characterized by decrease in appetite, weight loss, and death.
Animal Acute Toxicity	<p>Inhalation of high concentrations of ether produces central nervous system (CNS) changes, such as behavioral effects, excitation, depression, and unconsciousness. Male mice exposed by inhalation to 13 300-30000 ppm of diDiethyl ether for 20 min had decreased excitability, reduced muscle tone, and reduced sensorimotor activity. DiDiethyl ether is a mild eye irritant. The reported toxic doses for mice include the following: LC₅₀ (inhalation), 31000 ppm per 30 min; LD₅₀ (intraperitoneal), 2.4 g kg⁻¹ ; and LD₅₀ (intravenous) 996 mg kg⁻¹ .</p>
References	<p>U.S. Environmental Protection Agency (1987). <i>Drinking Water: Proposed Substitution of Contaminants and Proposed List of Additional Substances Which May Require Regulation Under the Safe Drinking Water Act</i>, Federal Register, 52:130, pp. 25720-25734.</p> <p>Lewis, R. J., Sr. (2002). <i>Hazardous Chemicals Desk Reference</i>, 5th ed., John Wiley & Sons, Hoboken, NJ.</p>

Warning: Hazmat Navigator has only partial information for some compounds. If a compound is not included or if information is not provided, DO NOT assume that the compound is without hazard. Proceed at your own risk.