Product Safety Assessment

UCAR™ Ethylene Glycol Aircraft Deicing & Anti-Icing Fluids

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Names
• CAS No. 107-21-1
• Ethylene glycol
• UCAR™ Aircraft Deicing Fluid Concentrate SAE/ISO Type 1
• UCAR Aircraft Deicing Fluid XL 54 SAE/ISO Type 1
• UCAR Aircraft Deicing Fluid “50/50” SAE/ISO Type 1
• UCAR Endurance EG106 Aircraft Deicing/Anti-icing Fluid SAE Type IV

Product Overview
• Dow manufactures a series of ethylene-glycol (EG) -based aircraft deicing and anti-icing fluids under the trade name UCAR™ deicing and anti-icing fluids. They are mixtures of ethylene glycol with water, corrosion inhibitors, wetting agents, and dyes. For further details, see Product Description.
• UCAR EG-based aircraft deicing fluids (ADF) are used for the removal of snow, ice, and frost from the exterior surfaces of aircraft. UCAR EG-based aircraft anti-icing fluids (AAF) are applied following aircraft deicing or during active precipitation to prevent additional snow or ice build-up over an extended period of time. AAF can also be used as a preventive by applying to dry aircraft when overnight frost is forecast. For further details, see Product Uses.
• Worker exposure to UCAR EG-based aircraft deicing and anti-icing fluids is possible during product formulation or during aircraft deicing or anti-icing operations. These fluids are commercial-grade products and are not available for home use. For further details, see Exposure Potential.
• Eye contact with these fluids may cause slight, temporary irritation, although corneal injury is unlikely. Prolonged skin contact is essentially nonirritating. Repeated contact may cause flaking and softening of the skin. According to generally accepted guidelines, ethylene glycol has moderate toxicity if ingested. At room temperature, exposure to vapor is minimal, however, vapor from heated material may cause respiratory irritation and other effects. For further details, see Health Information.
• Ethylene glycol, the main component of UCAR EG-based aircraft deicing and anti-icing fluids, is readily biodegradable, is unlikely to bioaccumulate in the food chain, and is practically nontoxic to fish and aquatic organisms. For further details, see Environmental Information.
• UCAR™ EG-based aircraft deicing and anti-icing fluids are thermally stable at typical storage and use temperatures. Some components of these products can decompose at elevated

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temperatures, causing pressure build-up in closed systems. Avoid contact with strong acids, strong bases, and strong oxidizers. Areas sprayed with these fluids (such as the tarmac) may become slippery.\textsuperscript{3, 5} For further details, see Physical Hazard Information.

Manufacture of Product

- **Capacity**\textsuperscript{6} – Total global production capacity of ethylene glycol was reported to be 19.6 million metric tons (43 billion pounds) in 2006. Actual consumption in 2006 was reported to be 17.0 million metric tons (37.5 billion pounds). Dow production facilities are located in St. Charles, Louisiana; Seadrift, Texas; Wilton, United Kingdom; and Terneuzen, The Netherlands. Additional production facilities of MEGlobal (a joint venture between Petrochemical Industries Company (PIC) of Kuwait and The Dow Chemical Company) are located at Fort Saskatchewan and Red Deer, Alberta, Canada.

- **Process**\textsuperscript{7} – Ethylene glycol is manufactured by a closed, single-reactor process using a catalyzed condensation reaction between ethylene oxide and a controlled amount of water as shown below. Higher glycols (di-, tri-, and tetraethylene glycol) are by-products. Ethylene glycol is then separated and purified by distillation.

Product Description\textsuperscript{1, 3, 8}

Ethylene glycol (EG) is a colorless, odorless liquid. It is soluble to some extent in a wide range of organic materials and is completely soluble in water. UCAR™ EG-based aircraft deicing and anti-icing fluids are mixtures of ethylene glycol with water, corrosion inhibitors, wetting agents, and dyes. Some products also contain thickeners. The dye is intended to indicate which parts of the aircraft have been treated and to differentiate between fluids (Type I fluids are orange, Type IV fluids are green).

Dow manufactures the EG-based aircraft deicing and anti-icing fluids listed below:

- **UCAR Aircraft Deicing Fluid Concentrate** SAE/ISO Type I – an orange-colored mixture of approximately 92% EG intended to be diluted with water prior to application.
- **UCAR Aircraft Deicing Fluid XL 54** SAE/ISO Type I – an orange-colored mixture of approximately 54% EG intended to be used undiluted. It is only available in Canada.
- **UCAR Aircraft Deicing Fluid “50/50”** SAE/ISO Type I – an orange-colored mixture of approximately 48% EG intended to be used undiluted.
- **UCAR Endurance EG106 Aircraft Deicing/Anti-icing Fluid** SAE Type IV – a green-colored mixture of approximately 50% EG intended to be used undiluted.

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These products conform to Aerospace Material Specifications 1424D, 1428D, and 1428E set by the Society of Automotive Engineers (SAE) International, as well as standards established by airframe manufacturers.\(^9\)

**Product Uses\(^{1,10,11}\)**

**UCAR™ EG-based aircraft deicing fluids (ADF)** – ADFs are used for removal of snow, ice, and frost from the exterior surfaces of aircraft. ADFs are normally applied hot and sprayed directly onto aircraft surfaces, especially wings and other control surfaces, immediately preceding takeoff.

**UCAR EG-based aircraft anti-icing fluid (AAF)** – During periods of active precipitation (snow, sleet, freezing rain), AAF is applied following the ADF operation. In addition to deicing functionality, it provides protection against the build-up of new snow or ice. It is generally applied to the leading edge and upper surface of the wing and to the horizontal stabilizer (tail section). The fluid forms a layer that absorbs snow or freezing rain. It prevents absorbed precipitation from refreezing. During takeoff, the AAF flows off the aircraft exterior. AAF can also be applied to dry aircraft as a preventive if overnight frost is expected.

**Exposure Potential**

Based on the uses for UCAR™ EG-based aircraft deicing and anti-icing fluids, the public could be exposed through:

- **Workplace exposure\(^3\)** – Exposure can occur at a manufacturing site. Those working with these products in production facilities could be exposed during maintenance, sampling, testing, or other procedures. Airfield personnel can be exposed during aircraft deicing and anti-icing operations. The potential for exposure is reduced by engineering controls and personal protective equipment. Facilities that manufacture or use these fluids should have a thorough training program for employees and appropriate work processes and safety equipment in place to limit unnecessary exposure. See **Health Information**.

- **Consumer exposure to UCAR EG-based aircraft deicing and anti-icing fluids** – Dow does not sell these products for consumer use. Under normal conditions of use, airline passengers and flight crews would not be expected to have any significant exposure to these fluids, and any odor detected by these individuals while the materials are being properly applied would be at an exposure level that is considered safe for humans. See **Health Information**.

- **Environmental releases\(^3\)** – Ethylene glycol may slowly evaporate from these products. Ethylene glycol is very soluble in water, and when introduced to water, will have a tendency to remain there. Because ethylene glycol is readily biodegradable, it will be removed from water and soil environments, including wastewater-treatment facilities. In the event of a spill, the focus is on containing the spill to prevent contamination of soil, ditches, sewers, waterways, or groundwater. For small spills, absorb the material with materials such as cat litter, sawdust, vermiculite, or Zorball. Collect the material in suitable and properly labeled
containers. These materials are not classified as dangerous to aquatic organisms. See Environmental, Health, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, dike the area to contain the spill. The material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Isolate the area and keep unnecessary or unprotected personnel from entering the area. Follow emergency procedures carefully. Excessive product accumulation on the tarmac during deicing or anti-icing operations should be removed by mechanical means (e.g., vacuum truck). See Environmental and Physical Hazard Information.

- **In case of fire** – Keep people away and deny unnecessary entry. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing or fight the fire from a safe distance. Use water fog or fine spray, dry-chemical or carbon-dioxide fire extinguishers, or foam. **Do not use** a direct water stream as it may spread the fire. Follow emergency procedures carefully. See Health and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

**Health Information**

The primary ingredient in UCAR™ EG-based aircraft deicing and anti-icing fluids is ethylene glycol. The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) has stated, “Your health is not likely to be seriously affected by the very small amounts of ethylene glycol that could be tasted or otherwise accidentally eaten (for example, by putting your fingers in your mouth after getting them wet with antifreeze). Accidental or intentional ingestion of larger amounts of ethylene glycol can cause serious illness or death.”

**Eye and Skin Contact** – Eye contact with liquid, vapor, or mist may cause slight irritation but corneal injury is unlikely. Brief skin contact is essentially nonirritating. Prolonged or repeated skin contact may cause slight irritation with local redness. Repeated or prolonged skin exposure to large quantities of ethylene glycol may result in absorption of harmful amounts. Massive contact with damaged skin or with material hot enough to burn the skin may result in absorption of potentially lethal amounts.

**Inhalation** – At room temperature, exposure to vapor is minimal due to the low volatility of the material. With good ventilation, a single exposure is not expected to cause adverse effects. If the material is heated or areas are poorly ventilated, vapor or mist may accumulate and cause respiratory irritation and symptoms such as headache and nausea.

**Ingestion** – The oral toxicity is expected to be moderate due to the presence of ethylene glycol. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing large amounts of ethylene glycol may cause nausea, vomiting, abdominal discomfort, diarrhea, and/or serious injury, even death. Excessive exposure may result in central nervous system effects, cardiopulmonary effects, and kidney failure.

**Repeated exposure** – Repeated excessive exposure in animals has been reported to cause kidney and liver effects. In humans, effects have been reported on the central nervous system, (for example, headache) and excessive repeated exposure to vapor or mist may cause irritation of the upper respiratory tract.

**Other effects** – Ethylene glycol did not cause cancer in long-term animal studies. Based on animal studies, ingestion of very large amounts of ethylene glycol appears to be the major and

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possibly only route of exposure to produce birth defects. Ingested in large amounts, ethylene glycol has also been shown to interfere with reproduction in animals. *In vitro* and animal genetic toxicity studies were negative.

For more information, see the relevant Safety Data Sheet.

**Environmental Information**

Ethylene glycol, the main component in UCAR™ EG-based aircraft deicing and anti-icing fluids, has a low volatility and may slowly evaporate from products containing it. The substance is very soluble in water, and when introduced, will have a tendency to remain in water. It has minimal tendency to bind to soil or sediment.

Ethylene glycol is unlikely to persist in the environment. The substance is readily biodegradable, which suggests the chemical will be removed from water and soil environments, including biological wastewater-treatment facilities.

Ethylene glycol is not likely to accumulate in the food chain (bioconcentration potential is low) and is practically nontoxic to fish and other aquatic organisms on an acute basis.

Environment Canada reviewed ethylene glycol and finalized the results in a Priority Substance List, State of the Science Report (2000). The assessment included the analysis of environmental exposures and effects from use in deicing/anti-icing operations. The report concluded that releases of ethylene glycol from current practices are unlikely to result in adverse effects when consideration is given to the seasonal nature and duration of the releases. The Organisation for Economic Co-operation and Development (OECD) Screening Information Data Set (SIDS) Initial Assessment Profile for ethylene glycol concluded that, based on the known properties and exposure patterns, the chemical is currently of low priority for further work due to its low hazard profile. (Link: [http://cs3-hq.oecd.org/scripts/hpv/Index2.asp?CASNUM=107211](http://cs3-hq.oecd.org/scripts/hpv/Index2.asp?CASNUM=107211))

For more information, see the relevant Safety Data Sheet.

**Physical Hazard Information**

Ethylene glycol is thermally stable at recommended storage and use temperatures. However, exposure to elevated temperatures can cause decomposition. Gas generated during decomposition can cause pressure build-up in closed systems. The decomposition products of ethylene glycol depend upon temperature, air supply, and the presence of other materials and may include aldehydes, alcohols, and ethers.

Ethylene glycol is incompatible with strong acids, strong bases, and strong oxidizers. Avoid contact with these materials.

For more information, see the relevant Safety Data Sheet.
Regulatory Information
Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of UCAR™ EG-based aircraft deicing and anti-icing fluids. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, Technical Data Sheet, or Contact Us.

Additional Information
- Safety Data Sheets (http://www.dow.com/webapps/msds/msdssearch.aspx)
- Contact Us (http://www.dow.com/aircraft/contact/index.htm)


References
3 UCAR Aircraft Deicing Fluid Concentrate SAE/ISO Type I Material Safety Data Sheet, The Dow Chemical Company

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8 UCAR Endurance EG106: Ethylene Glycol Type IV Aircraft Deicing/Anti-icing Fluid, Product Information, The Dow Chemical Company, Form No. 183-00101-0713 AMS, July 2013, pages 6, 8, and 17-19.
9 Dow Aircraft Deicing and Anti-icing website: Products
11 Estimates by The Dow Chemical Company.

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