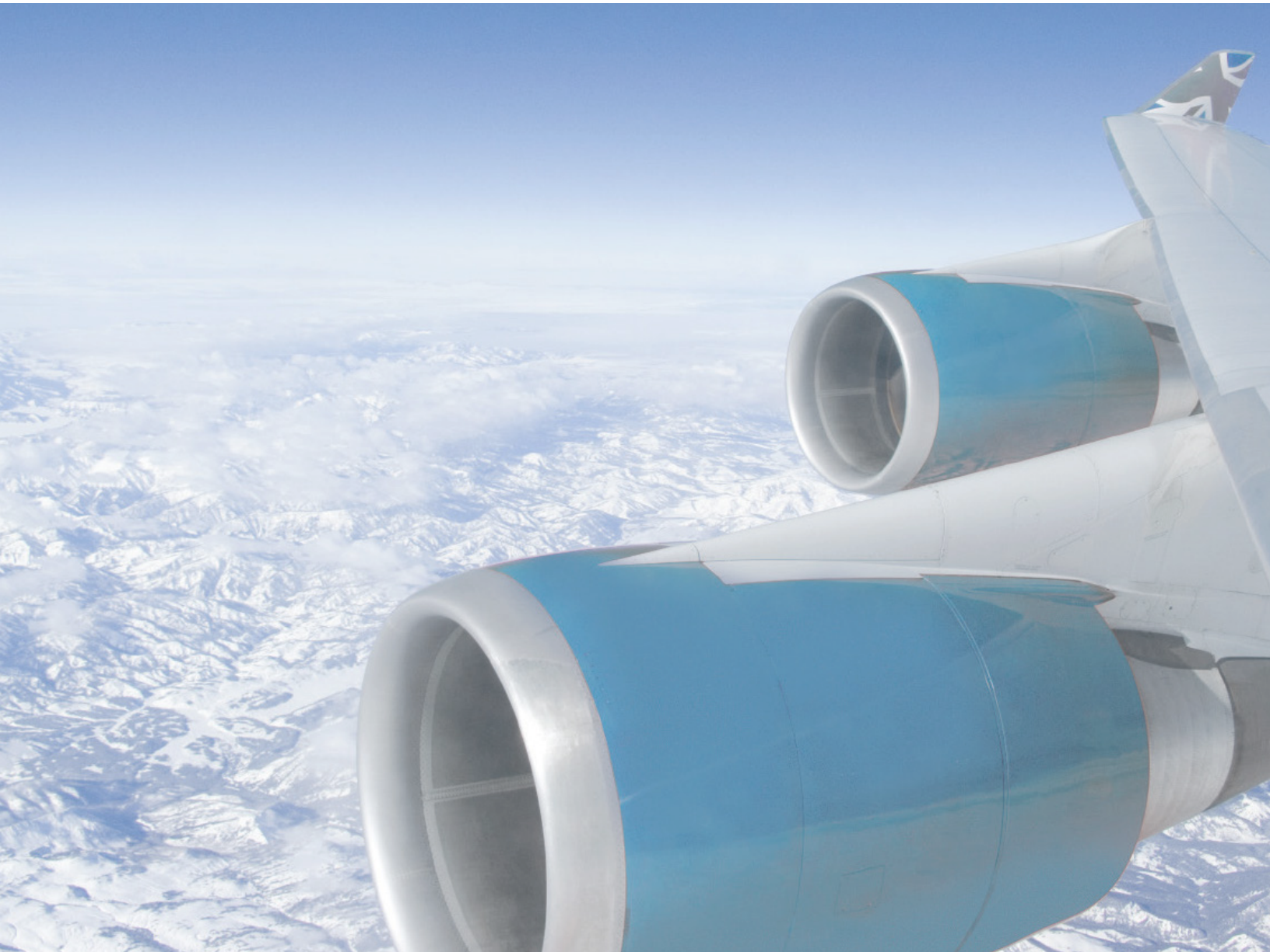
Dow Industrial Solutions

UCAR ENDURANCE™ EG106

Ethylene Glycol Type IV Aircraft Deicing/Anti-Icing Fluid



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Abbreviations and Symbols

Abbreviation/Symbol	Meaning
AAF	Aircraft Anti-icing Fluid
ADF	Aircraft Deicing Fluid
ADF/AAF	Aircraft Deicing/Anti-icing Fluid
AMS	Aerospace Material Specification
APU	Auxiliary Power Units
ARP	Aerospace Recommended Practice
AS	Aerospace Standard
ASTM	American Society for Testing and Materials
COD	Chemical Oxygen Demand
EC_{50}	Effective Concentration that can immobilize 50% of the test population during a defined exposure period
FAA	Federal Aviation Administration (U.S.)
HHET	High-Humidity Endurance Test
HOT	Holdover Time
kg	Kilogram
LC_{50}	Concentration that is lethal to 50% of the test population during a defined exposure period
LOUT	Lowest Operational Use Temperature
LOWV	Lowest On-wing Viscosity
mg/L	Milligrams per liter
MOWV	Maximum On-wing Viscosity
NOEC	No-observed-effect concentration
O_2	Oxygen
OAT	Outside Air Temperature
SAE	Society of Automotive Engineers
SDS	Safety Data Sheet
U.S.	United States (of America)
UV	Ultraviolet
WSET	Water Spray Endurance Test
>	Greater than
<	Less than

Introduction

Product Description

UCAR ENDURANCE™ Aircraft Deicing/Anti-icing Fluid (ADF/AAF) is designed to protect aircraft against the accumulation of ice, snow, and frost. UCAR ENDURANCE EG106 ADF/AAF is an SAE[1] Aerospace Material Specification (AMS) 1428/1 fluid that contains ethylene glycol, water, corrosion inhibitors, wetting agents, thickener, and green dye. UCAR ENDURANCE EG106 ADF/AAF nominally contains 50% ethylene glycol, 49% water, and less than 1% of the other formulation ingredients. UCAR ENDURANCE EG106 ADF/AAF is formulated to be used neat (undiluted) as an anti-icing fluid for extended protection time during winter precipitation conditions.

SAE Aerospace Standard (AS) 6285 requires that flight crews be informed about the percentage of Type IV fluid/water mixture. By definition, neat (undiluted as shipped by the manufacturer) Type IV fluid is 100/0, that is 100 parts of neat fluid and 0 parts of user-added water. For the purpose of communications with flight crews, the concentration of neat UCAR ENDURANCE EG106 ADF/AAF is 100.

DO NOT DILUTE UCAR ENDURANCE EG106 ADF/AAF
If you have any questions, please contact your Dow representative.

Conformance to Industry Standards

UCAR ENDURANCE EG106 ADF/AAF conforms to the technical requirements of the most current version of SAE AMS 1428/1. Periodic re-qualification is also done in accordance with this international industry fluid standard. Copies of certificate of conformance are available upon request. Holdover guidelines are only available for the neat (100/0) fluid.

Recommended Use Practices

Ice, snow, and frost adhering on the surface of an aircraft may adversely affect flight. Deicing and anti-icing aircraft provides temporary protection from ice adhering to aircraft surfaces. It does not ensure that ice will not accrete on aircraft surfaces during take-off and in flight. Fluid use guidelines and Holdover Time Tables are published by regulatory agencies such as Transport Canada and the U.S. Federal Aviation Administration. SAE AS 6285 describes deicing and anti-icing processes. UCAR ENDURANCE EG106 ADF/AAF should be used in accordance with these documents to design a program for safe and effective winter deicing and anti-icing operations. Also see Application section (pages 14-15).

Important Note:
This product information bulletin contains important safety information. Read the entire product information bulletin before using UCAR ENDURANCE EG106 ADF/AAF. Read, understand and comply with the Safety Data Sheet for this product before using.

Hazards of Ice, Snow and Frost

A very small amount of ice, snow or frost, with thickness levels as low as 0.36 mm (1/64 in.), can cause roughness that will disrupt the airflow over lift and control surfaces of an aircraft. The consequences of this roughness are severe lift loss and impaired maneuverability. Ice can also interfere with the movement of aircraft control surfaces and/or add significantly to aircraft weight. There is no such thing as an insignificant amount of ice on an aircraft.

Ice can form even when the outside air temperature (OAT) is well above 0°C (32°F). An aircraft equipped with wing fuel tanks will have fuel that, after a certain amount of flight time, may reach a sufficiently low temperature to cool the wing temperature below the OAT. This phenomenon is known as cold soaking.

Cold soaking can also be caused by fueling an aircraft with cold fuel. If there is rain or high humidity, ice can form on the cold-soaked wing and accumulate over time. This ice can be invisible to the eye and is often referred to as clear ice. This ice can be detected by running one's hand over the aircraft surface or by using specially-designed ice-detecting cameras.

Chunks of clear ice dislodged during takeoff and climb can be ingested by aft-mounted engines, thus damaging and possibly stopping them. Chunks of clear ice can also damage critical aircraft surfaces. Cold soaking is a problem for any aircraft, not just those with aft-mounted engines, because the ice formed may be rough and cause lift loss and impair maneuverability.

Definition of Ice, Snow and Frost

Note that throughout this product information bulletin, the terms ice, snow and frost may include any form of frozen accumulation, such as water, ice, snow, slush, snow pellets, snow grains, frost, hoarfrost, rime, glaze, etc. as well as mixtures of deicing/anti-icing fluids with such frozen accumulation.

[1]SAE Standards available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA. (877) 606-7323 (U.S. and Canada) or (724) 776-4970 (outside the U.S.) www.sae.org

Typical Properties for UCAR ENDURANCE™ EG106 ADF/AAF

Typical performance and physical properties of UCAR ENDURANCE EG106 ADF/AAF are listed in Table 1. Additional information on these properties can be found on pages 6-7. Operational property information is contained on pages 7-8.

Table 1: Typical Performance and Physical Properties of UCAR ENDURANCE EG106 ADF/AAF[2]

Typical Performance Properties		Typical Physical Properties	
Effect on Aircraft Materials and Pavement Compatibility	Compliance with SAE AMS1428[3]	**Appearance**	Green liquid
Water Spray Endurance Test Time, SAE AS5901, 100/0 (neat fluid)	>120 minutes	**Surface Tension, ASTM D1331, 20°C**	26 dynes/cm
High Humidity Endurance Test Time, SAE AS5901, 100/0 (neat fluid)	>12 hours	**Viscosity, #31 spindle, 0.3 rpm, 0°C**	40,000 mPa•s
Freezing Point, ASTM D1177, 100/0 (neat fluid)	-36°C (-32.8°F)	**pH, ASTM E70, 25°C**	8.2
Freezing Point with 7°C (about 13°F) buffer	-29°C (-20.2°F)	**Specific Gravity, ASTM D891, 20°C**	1.069
Aerodynamics, High-speed Ramp test, SAE AS5900, 100/0 (neat fluid)	-29°C (-20.2 F)	**Refractive Index, ASTM D1747, 20°C**	1.3844
		Refractive Index, 20°C	32° Brix
Lowest Operational Use Temperature (LOUT)[4], high-speed aircraft	-29°C (-20.2°F)	**Flash Point, ASTM D93**	No flash to 100°C (212°F)

[2]Typical Properties, not to be construed as sales specifications.

[3]AMS1428 encompasses the following compatibility tests: sandwich corrosion (ASTM F110), total immersion corrosion (ASTM F483), low-embrittling cadmium plate (ASTM F1111), stress-corrosion resistance (ASTM F945, Method A), hydrogen embrittlement (ASTM F519), effect on transparent plastics (ASTM F484), effect on painted surfaces (ASTM F502), effect on unpainted surfaces (ASTM F485) and runway concrete scaling resistance (ASTM C672).

[4]See Lowest Operational Use Temperature section (page 7).

Performance Properties

Effect on Aircraft Materials and Pavement

UCAR ENDURANCE™ EG106 ADF/AAF meets the materials compatibility requirements of major airframe manufacturers and industry associations (see Table 1, page 5). Material compatibility tests are performed by an independent laboratory. Detailed results from these tests are available from your Dow representative.

Water Spray Endurance Test

The Water Spray Endurance Test (WSET) was developed as a laboratory test to simulate aircraft anti-icing fluid behavior in freezing precipitation. A complete description of this procedure can be found in SAE Aerospace Standard (AS) 5901. Under these laboratory conditions, UCAR ENDURANCE EG106 ADF/AAF typically has a WSET time of greater than 120 minutes. This time exceeds the SAE AMS1428 Type IV minimum requirement of 80 minutes.

Although the product in both its neat and diluted form met SAE AMS1428/1 WSET technical requirements, this product is most effective when used neat. Holdover guidelines are only available for the neat (100/0) fluid. The Dow Chemical Company recommends that UCAR ENDURANCE EG106 ADF/AAF be used only neat and warns the user:

DO NOT DILUTE UCAR ENDURANCE EG106 ADF/AAF
If you have any questions, please contact your Dow representative.

High Humidity Endurance Test (HHET)

The High Humidity Endurance Test (HHET) was developed as a laboratory test to simulate aircraft anti-icing fluid behavior under certain frosting conditions. A complete description of this procedure can be found in SAE Aerospace Standard (AS) 5901. Under these laboratory conditions, UCAR ENDURANCE EG106 ADF/AAF typically has a HHET time of greater than 12 hours. This time exceeds the SAE AMS1428/1 Type IV minimum requirement of 8 hours.

Aerodynamics

Deicing and/or anti-icing fluid remaining on the aircraft following the deicing and/or anti-icing operation can affect the aerodynamic performance of any aircraft. As temperature decreases, UCAR ENDURANCE EG106 ADF/AAF viscosity generally becomes more viscous and can have an increased effect on aerodynamics. The objective of aerodynamic acceptance tests is to determine the coldest temperature at which the deicing or anti-icing fluid has acceptable characteristics as it flows off during takeoff ground acceleration and climb.

There are two separate aerodynamic acceptance tests for aircraft deicing and anti-icing fluids: one for faster aircraft (high-speed ramp test) and one for slower aircraft (low-speed ramp test). The high-speed ramp aerodynamic test establishes flow-off requirements for fluids used to deice or anti-ice large transport jet aircraft with rotation speeds generally exceeding approximately 100 knots and with time from brake release to rotation speed greater than 20 seconds. The other test, known as the low-speed ramp test, establishes flow-off requirements for commuter- type aircraft with take-off rotation speeds exceeding approximately 60 knots and with time from brake release to rotation speed greater than 15 seconds. Both tests are fully described in SAE AS5900.

UCAR ENDURANCE EG106 ADF/AAF was evaluated and qualified to AS5900 using the high-speed ramp aerodynamic acceptance test at temperatures above -29°C (-20.2°F). Since the geometry of the wing and control surfaces, takeoff speed and ground roll time are the responsibility of the airframe manufacturer, Dow recommends the use of UCAR ENDURANCE EG106 ADF/AAF only if the airframe manufacturer has approved the use of SAE AMS1428/1 Type IV fluids (or specifically UCAR ENDURANCE EG106 ADF/AAF) for use on its aircraft.

Some airframe manufacturers have allowed the use of Type IV fluids on their low-speed aircraft. Dow recommends the use of UCAR ENDURANCE EG106 ADF/AAF on low-speed aircraft only if the airframe manufacturer has approved the use of Type IV fluids (or specifically UCAR ENDURANCE EG106 ADF/AAF) for use on its aircraft.

Freezing Point

UCAR ENDURANCE EG106 ADF/AAF is formulated to provide freeze protection and a viscosity suitable for outside storage and handling. UCAR ENDURANCE EG106 ADF/AAF has a freezing point of -36°C (-32.8°F). The addition of water (e.g., through contamination or precipitation) raises the freezing point, reducing its effectiveness. Therefore, freezing point of the fluid should be checked frequently and regularly to help ensure safe winter operations. Freezing point can be measured directly, using a method such as ASTM D1177. However, this method is cumbersome for use in the field. The freezing point of UCAR ENDURANCE EG106 ADF/AAF can be effectively and easily monitored in the field by measuring the refractive index of the fluid. See Refractive Index for additional information (page 12).

Lowest Operational Use Temperature

The lowest operational use temperature (LOUT) of an anti-icing fluid is generally recognized as the higher of:
1. the lowest temperature at which it meets the aerodynamic acceptance test for a given type of aircraft, or
2. the freezing point of the fluid plus the freezing point buffer of 7°C (about 13°F).

A fluid must not be used when the outside ambient temperature or skin temperature of the aircraft is below the LOUT of the fluid. The LOUT for UCAR ENDURANCE™ EG106 ADF/AAF is listed in Table 1 (page 5).

Physical Properties

Surface Tension

UCAR ENDURANCE EG106 ADF/AAF has a low surface tension (see Table 1), which enables the fluid to provide rapid and uniform wetting and spreading on the surface of the aircraft.

Viscosity

UCAR ENDURANCE EG106 ADF/AAF is a shear thinning, non-Newtonian fluid. Its viscosity is high when the fluid is at rest, but is lower when the fluid is subjected to shearing forces. Since the viscosity varies with temperature and, for non-Newtonian fluids, is dependent on the force applied to the fluid, when viscosities are measured it is important to specify precisely the methods of measurement. See Viscosity (page 12) under Product Testing (page 11) for fluid testing information and acceptable range of results for UCAR ENDURANCE EG106 ADF/AAF.

pH, Specific Gravity, and Refractive Index

The pH, specific gravity, and refractive index values for UCAR ENDURANCE EG106 ADF/AAF are provided in Table 1. These properties are discussed further under Product Testing (pages 11-13).

Flash Point

UCAR ENDURANCE EG106 ADF/AAF has no flash point as measured by ASTM D93. During normal use and proper storage and handling conditions, UCAR ENDURANCE EG106 ADF/AAF is considered to be non-flammable.

Operational Properties

Sprayability and Visibility

UCAR ENDURANCE EG106 ADF/AAF is provided as a vibrant emerald green liquid. The green color provides an excellent visual aid to assist in the application and detection of fluid on aircraft surfaces. UCAR ENDURANCE EG106 ADF/AAF showed no viscosity degradation when sprayed through commercial anti-icing trucks in a field spray trial test. When UCAR ENDURANCE EG106 ADF/AAF is being sheared (such as when it is pumped or passed through a nozzle) its viscosity is reduced. This allows atomization of the fluid and ease of spray. Yet after it reaches the aircraft surface, the fluid regains its high viscosity to form a protective coating which will be almost dripless when properly applied.

Shear Stability

Aircraft deicing and anti-icing fluids are subjected to shear whenever they are pumped or passed through a nozzle or restriction device. If the shear is not excessive, UCAR ENDURANCE EG106 ADF/AAF will recover its high viscosity and provide anti-icing protection for the aircraft surface while the aircraft is at rest. UCAR ENDURANCE ADF/AAF showed no viscosity degradation when sprayed through commercial anti-icing trucks in a field spray trial test. Additionally, when tested using the shear stability test in SAE AMS1428 (section 3.2.2.7.1), UCAR ENDURANCE EG106 ADF/AAF did not lose viscosity after 45 minutes of mixing with a Waring blender set at 2000 rpm. For more information on fluid shear stability see Shear Degradation (page 10).

Thermal Stability and Accelerated Aging

UCAR ENDURANCE EG106 ADF/AAF meets the thermal stability requirements of SAE AMS1428/1. However, like all Type IV fluids, it is possible to degrade UCAR ENDURANCE EG106 ADF/AAF by excessive heating. For more information, see Heating UCAR ENDURANCE EG106 ADF/AAF (page 10).

Thin Layer Thermal Stability

Leading-edge heating devices can be activated in a few instances while an aircraft is on the ground. In such cases, the anti-icing fluid is subjected to high temperatures. UCAR ENDURANCE EG106 ADF/AAF does not leave an insoluble residue in the SAE AMS1428 test designed to simulate conditions created by these thermal devices.

Successive Dryout and Rehydration

The industry has become aware of the potential for thickened SAE AMS1428 Type II, Type III, and Type IV fluids, especially when used in a one-step process, to form gels and residues upon dryout. Several airlines, mostly those in Europe, have reported incidents in which residues of thickened fluids in aerodynamically quiet areas rehydrated and froze at altitude, thereby restricting the movement of or blocking control surfaces. The use of a two-step deicing/anti-icing process, where the first step is a Type I fluid, reportedly reduces the propensity for residue formation (see Application, pages 14-15).

A test procedure has been developed to evaluate fluid performance under simulated dryout and rehydration conditions and is described in Appendix A of SAE AMS1428. Users should inspect aircraft as recommended in SAE AS6285. If residues are present, users should evaluate their application practices and establish an appropriate inspection and cleaning program.

Environmental Properties

Environmental Impact

UCAR ENDURANCE™ EG106 ADF/AAF generally will not persist in the environment, but can be harmful to aquatic life if discharged into a receiving waterway without further dilution. Collection and treatment, including glycol reclamation, of spent aircraft deicing and anti-icing fluids is recommended. For additional product safety information, consult Dow's Material Safety Data Sheet for UCAR ENDURANCE EG106 ADF/AAF.

Biodegradation

UCAR ENDURANCE EG106 ADF/AAF should be readily biodegraded in both surface water and conventional wastewater treatment plants. The use of ethylene glycol in UCAR ENDURANCE EG106 ADF/AAF produces a fluid with a lower chemical oxygen demand (COD) when compared with propylene glycol-based fluids. The COD for UCAR ENDURANCE EG106 ADF/AAF was determined to be 0.51 kg O_2/kg fluid.

Large discharges of this product or any other readily biodegradable substance could result in a temporary reduction or depletion of dissolved oxygen levels in the receiving waterways, with a potential adverse effect on aquatic life. Generally, low winter temperatures and increased dilution from stormwater flow during periods of use tend to minimize any adverse effects on dissolved oxygen levels and aquatic life.

Effect on Aquatic Life

Aquatic tests on UCAR ENDURANCE EG106 ADF/AAF show that this product is practically non-toxic to aquatic organisms on an acute basis with lethal concentration (LC_{50}) and effect concentration (EC_{50}) values >100 mg/L in the most sensitive species tested. Despite this favorable environmental profile, collection and treatment of spent aircraft deicing and anti-icing fluids is recommended. Aquatic toxicity test data for UCAR ENDURANCE EG106 ADF/AAF is summarized in Table 2 below.

Glycol Recovery, Collection and Disposal

UCAR ENDURANCE EG106 ADF/AAF contains a high-quality grade of ethylene glycol. This single glycol component formulation will facilitate ethylene glycol reclamation from used deicing fluids. Recovered glycol must be tested for the intended end use and recertified where applicable.

Appropriately contain, collect and dispose of runoff from deicing operations and divert to permitted outfalls or to a waste treatment system. Check with local authorities to assure compliance with federal, state, provincial and local laws. It is the responsibility of the user to assure disposal is appropriate and in compliance with legal requirements.

Table 2: Aquatic Toxicity of UCAR ENDURANCE™ EG106 ADF/AAF

Test Organism	mg/L	NOEC*, mg/L
Daphnia magna 48 hr. EC_{50}	216	104
Rainbow trout 96 hr. LC_{50}	526	168

*NOEC: No observed effect concentration

Storage and Handling

Availability

UCAR ENDURANCE™ EG106 ADF/AAF is available from Dow in drums, tote tanks, or bulk.

Materials Compatibility

Materials. UCAR ENDURANCE EG106 ADF/AAF, when stored as directed, is not corrosive and will not damage materials such as carbon steel, aluminum, stainless steel, and most fiberglass-reinforced plastics commonly used to construct storage tanks, transfer lines, and fittings. See Storage Tanks (page 10) for additional information.

Galvanic couples. Care should be taken to avoid using dissimilar metals in contact with each other, as galvanic couples may form and degrade the fluid. For example, when aluminum is in contact with stainless steel, trivalent aluminum ions are released. These multivalent ions then complex with the thickener system of UCAR ENDURANCE EG106 ADF/AAF and its viscosity is reduced. Often gels or wispy white residue can be seen directly on metals where there is a galvanic couple present.

Elastomers. UCAR ENDURANCE EG106 ADF/AAF is compatible with many elastomers used in hoses, gaskets, and seals as shown in Table 3.

Table 3: Compatibility of UCAR ENDURANCE™ EG106 ADF/AAF with Various Elastomers

Elastomer	25°C (77°F)	70°C (158°F)
Adiprene L-100	Good	Poor
Black Rubber 3773	Good	Poor
Buna N	Good	Good
Buna S	Good	Fair
Butyl Rubber	Good	Good
Compressed Asbestos	Good	Good
EPDM	Good	Good
EPR Rubber	Good	Good
Hycar, D-24	Good	Fair
Hypalon	Good	Poor
Kalrez	Good	Good
Natural Rubber Gum	Good	Poor
Neoprene 7797	Good	Fair
Red Rubber #107	Good	Poor
Saraloy 300	Good	Poor
Silicone No. 65	Good	Good
Viton A	Good	Good

Storage Tanks

Coated carbon steel, opaque fiberglass-reinforced polyester, opaque polyethylene, and stainless steel are satisfactory materials for storage tanks. Although UCAR ENDURANCE™ EG106 ADF/AAF is compatible with carbon steel, corrosion in carbon steel tanks can occur in the vapor space of partially empty tanks by evaporation and subsequent condensation of water from the aircraft anti-icing fluid. To prevent corrosion with carbon steel, use coated carbon steel tanks or keep tanks containing aircraft anti-icing fluid full during the summer and other periods of low use. Read Materials Compatibility (including the Galvanic Couples section) section on page 9 and UV degradation section below. See also Contamination section (page 13).

UV Degradation

Viscosity Decrease. UCAR ENDURANCE EG106 ADF/AAF will degrade when stored and exposed to ultraviolet light (UV), with a resulting loss in viscosity.

Dye Fading. The dye in UCAR ENDURANCE EG106 ADF/AAF is designed to degrade upon exposure to UV. When exposed to UV light, UCAR ENDURANCE EG106 ADF/AAF will progressively fade in color. Sight tubes on trucks or storage tanks should not be used to judge the appearance of the fluid in the vessel.

Preclusion of UV Degradation. Do not store UCAR ENDURANCE EG106 ADF/AAF in clear or semi-transparent plastic, polyethylene, fiberglass or glass storage tanks, containers or bottles. Sunlight and fluorescent lights are sources of UV light. If any UV transparent vessel is used, cover it with an opaque material or an opaque coating, preferably light in color. Dark colors tend to generate higher temperature inside the container when exposed to sunlight.

Shear Degradation

UCAR ENDURANCE EG106 ADF/AAF may permanently lose visosity if subjected to excessive shear.

Pumps. To lessen possible shear degradation, use low-shear pumps (e.g., diaphragm or progressive cavity) or air pressure for transfer. Centrifugal pumps may be used only if their suitability has been established through field tests. Do not circulate for extended periods. Do not use other high-shear pumps unless their suitability has been established.

Filters. Do not filter UCAR ENDURANCE EG106 ADF/AAF. Pumping through filters may subject the fluid to excessive high-shear conditions resulting in viscosity degradation.

Heating UCAR ENDURANCE EG106 ADF/AAF

Storage Temperature. Ideally, UCAR ENDURANCE EG106 ADF/AAF should be stored unheated. Avoid unnecessary heating of UCAR ENDURANCE EG106 ADF/AAF as there may be water evaporation or thermal degradation, both of which can result in the product falling outside of acceptable use limits (see Product Testing, pages 11-13). It is not sufficient to simply rely on a refractive index measurement to ensure that the fluid still meets requirements. Perform a viscosity test often to ensure that the viscosity is still within test requirements.

If heated, keep the UCAR ENDURANCE EG106 ADF/AAF temperature below 70°C (158°F). Try to minimize water evaporation by keeping the lids closed on anti-icing equipment, but keep vents open at all times to avoid a pressure build-up. We also recommend that heating elements be turned off when equipment designed for deicing is being used to apply the aircraft anti-icing fluid. Indirect heating due to the proximity of uninsulated deicing fluid truck tanks can be a very significant source of heat.

Filters. Do not filter UCAR ENDURANCE EG106 ADF/AAF. Pumping through filters may subject the fluid to excessive high-shear conditions resulting in viscosity degradation.

Shelf Life

Under normal ambient storage conditions, the shelf life of UCAR ENDURANCE EG106 ADF/AAF exceeds one year. Quality control tests should be repeated every year (see Product Testing, pages 11-13). However, more frequent testing is prudent to ensure the fluid is still acceptable for use. Under heated conditions, UCAR ENDURANCE EG106 ADF/AAF should be checked more often and regularly. Material not meeting test requirements should be sent to Dow for further testing.

Receiving

Avoid product contamination (see Contamination, page 13). Do not unload UCAR ENDURANCE EG106 ADF/AAF into your storage tank or trucks if one of the following conditions occurs:

1. The shipping documents or product label shows the fluid not to be UCAR ENDURANCE EG106 ADF/AAF, or
2. the BRIX reading of the delivered product does not fall in the acceptable product range (see Field Tests and Acceptable Range of Results), or
3. the color is not green, or
4. the UCAR ENDURANCE EG106 ADF/AAF is not substantially free from suspended matter.

Tarmac

Pavement covered with UCAR ENDURANCE EG106 ADF/AAF may be messy for ground vehicles or ground crews walking on the tarmac. Use caution in walking or in operating equipment in those areas where UCAR ENDURANCE EG106 ADF/AAF may be on the pavement. Wipe your feet before entering buildings, vehicles, or aircraft. If there is accumulation on the tarmac, use mechanical means (e.g., vacuum trucks) to remove the fluid. Avoid the use of solid absorbents on UCAR ENDURANCE EG106 ADF/AAF unless the absorbent is to be immediately removed from the pavement.

Runway

SAE Type IV aircraft anti-icing fluids are viscous and are designed to shear off the aircraft as it accelerates during the takeoff run, thus depositing some anti-icing fluid onto the runway. The SAE Type IV fluid deposited on the runway may cause snow to
melt and change the reported surface condition. Loose blowing snow may adhere to the anti-icing fluid, increasing the accumulation of snow on the runway. This effect may eventually create slush and ice conditions, resulting in lower friction values in the first third of the runway. This effect is dependent upon weather conditions and the amount of aircraft traffic. If the runway is used for mixed operations (both take-offs and landings); this may create an increased risk for landing aircraft.

Airport operators should be aware of this potential issue. Additional airfield maintenance by timely runway sweeping and application of formate or acetate-based runway deicing fluid to the area where the anti-icing fluid is deposited will eliminate or significantly reduce the accumulation of the anti-icing fluid.

Product Testing

Field Tests and Acceptable Range of Results

UCAR ENDURANCE EG106 ADF/AAF should be routinely sampled and tested for appearance/color, refractive index, pH and viscosity. The acceptable ranges of results for UCAR ENDURANCE EG106 ADF/AAF are listed in Table 4 below. Additional information on these fluid properties and product testing is included below. Keep records of the test results. Material not meeting these requirements should be sampled and sent to Dow for further testing. Whenever collecting samples, it is important to obtain a representative sample. A Sampling Guideline is available from your Dow representative.

Appearance. UCAR ENDURANCE EG106 ADF/AAF should be substantially free from suspended matter, and must not have any oily residues within or on the surface. The presence of oily residue is a form of contamination. Such contamination may interfere with the wetting capabilities of the fluid. A fluid that does not wet well may have significantly shorter holdover times. Do not use a fluid that has any sign of an oily residue. The presence of a slight haze or air bubbles in UCAR ENDURANCE EG106 ADF/AAF is normal.

Upon standing at rest (without agitation) for an extended period of time, UCAR ENDURANCE EG106 ADF/AAF may form globules (also described as globs/lumps) that are immediately dispersed with any fluid movement. The presence of these globules is considered normal for UCAR ENDURANCE EG106 ADF/AAF. If a gel is present, investigate the potential of galvanic coupling (see Materials Compatibility, Galvanic Couples section, page 9).

Table 4: Field Tests for UCAR ENDURANCE™ EG106 ADF/AAF

Property	Acceptable Range
Appearance/color	· Green liquid, a slight haze is permissible · Substantially free from suspended matter · Air bubbles may be present
Refractive Index at 20°C	30.5-33.5°BRIX
pH	7.9-8.9
Lowest on-wing viscosity[5] (LOWV)	24,850 mPa•s minimum
Maximum on-wing viscosity[5] (MOWV)	47,800 mPa•s minimum

[5]Brookfield Spindle SC4-31/13R, 10 mL fluid at 0°C, 0.3 rpm for 10 minutes

Color. UCAR ENDURANCE™ EG106 ADF/AAF is green. If the color is different, the sample is considered unacceptable. UCAR Aircraft Deicing Fluids (ADFs) are orange. Sight tubes on trucks or storage tanks should not be used to judge the appearance of the fluid in the vessel. Do not depend on color alone to determine that the correct product has been delivered or is being used. Always check the label, shipping papers, and refractive index.

Refractive index. Refractive index is related to the concentration of ethylene glycol, the freezing point depressant contained in UCAR ENDURANCE EG106 ADF/AAF, and, therefore, to its freezing point. Thus, the freezing point of UCAR ENDURANCE EG106 ADF/AAF can be effectively and easily monitored in the field by measuring the refractive index of the fluid. Temperature-compensated portable refractometers can be conveniently used for measurements in the field. Select a refractometer that can be calibrated easily, read easily, and covers the refractive index range to be measured in °BRIX. Do not use an (automotive) hydrometer for estimating freezing points. It does not have sufficient accuracy for the determination of the freezing point of aircraft deicing formulations. Read Selection and Care of Refractometers section for additional guidance. See Table 4 (page 11) on the previous page for the acceptable range for refractive index of UCAR ENDURANCE EG106 ADF/AAF.

pH. The pH can be measured easily using a portable pH meter. These meters are available from several laboratory equipment vendors. See Table 4 for the acceptable range for pH of UCAR ENDURANCE EG106 ADF/AAF.

LOWV. The lowest on-wing viscosity (LOWV) is based on the value obtained from the UCAR ENDURANCE EG106 ADF/AAF fluid sample that was provided for holdover time testing. For holdover time guidelines to be valid, the viscosity of the neat fluid on the wing shall not be lower than the LOWV. The user should periodically test fluid to ensure that the viscosity of UCAR ENDURANCE EG106 ADF/AAF is not lower than that listed in Table 4. See Viscosity information below. At the discretion of the user, samples can be submitted to Dow for a detailed inspection of the fluid.

MOWV. The maximum on-wing viscosity (MOWV) is based on the value obtained from the fluid that was provided as the High Viscosity UCAR ENDURANCE EG106 ADF/AAF Preproduction Sample for SAE AMS1428 testing. Fluid samples with a viscosity value higher than the MOWV must not be used. See Viscosity information below. Samples can be submitted to Dow for a detailed inspection of the fluid.

Viscosity. Since the viscosity varies with temperature and, for non-Newtonian fluids, is dependent on the force applied to the fluid, when viscosities are measured it is important to specify precisely the methods of measurement. For instance, with a rotational viscometer, temperature, viscometer model, rotation speed, spindle number, and time after beginning of rotation must be reported. For quality control purposes, Dow recommends the following method to be used to measure the viscosity of UCAR ENDURANCE EG106 ADF/AAF:

1. Centrifuge the sample to remove air bubbles. Air bubbles interfere with viscosity measurements.
2. Use a Brookfield Digital Viscometer Model DV-II, or equivalent, equipped with a small sample adapter and thermostatic chamger (SC4-31/13R).
3. Control the thermostatic chamber at 0°C ± 0.5 using a constant temperature bath.
4. Place 10 mL of the bubble-free UCAR ENDURANCE EG106 ADF/AAF into the Brookfield small sample adapter with spindle 31.
5. Wait 15 minutes for the sample temperature to equilibrate to 0°C. Prevent condensation water from contaminating the sample.
6. Start the rotation of the Brookfield viscometer spindle at 0.3 rpm.
7. Take the reading at exactly 10 minutes ± 1 second.
8. Report the result in mPa•s.

A detailed procedure is available upon request.

Test Frequency

Field tests for UCAR ENDURANCE EG106 ADF/AAF should be conducted annually, before the deicing season begins, and performed on a regular basis. Test samples from all storage vessels and truck tanks. Use the fluid only if the label, appearance/color, refractive index, pH and viscosity are within the accepted ranges listed in Table 4.

Whenever fluids are transferred, check the label (on both the sources and receiving vessel), appearance/color, refractive index, pH and viscosity of the fluid in the receiving vessel after the transfer. Use only if the test results are within the acceptable ranges of results listed in Table 4. Receiving is a form of transfer (see Receiving, page 10).

If UCAR ENDURANCE EG106 ADF/AAF is heated or stored in trucks with uninsulated tanks that permit heat to transfer to the UCAR ENDURANCE EG106 ADF/AAF tanks, field tests should be performed frequently (see Heating UCAR ENDURANCE EG106 ADF/AAF, page 10).

Tests by Dow

Send samples to Dow for a full analysis and confirmation of acceptability when (1) product samples tested fail to meet all requirements; (2) contamination, either accidental or willful, is suspected; or (3) you deem for any reason that such confirmation is necessary.

Selection and Care of Refractometers

Criteria. Temperature-compensated portable refractometers can be conveniently used for measurements in the field. Select a refractometer that can be calibrated easily, read easily, and covers the refractive index range to be measured in °BRIX.

Commercially available refractometers. Examples of temperature-compensated portable refractometers are the MISCO 10431VP, PA201, and PA202[6] and Rhino Brix50[7]. Among the refractometers which should **not** be used are: the MISCO 7084VP or 7064VP refractometers. Also do not use battery testers to test the refraction of UCAR ENDURANCE EG106 ADF/AAF.

Hydrometer. Do NOT use an (automotive) hydrometer for estimating freezing points. It does not have sufficient accuracy for the determination of the freezing point of aircraft deicing fluid formulations.

According to the refractometer manufacturers[6,7,] temperature compensated refractometers, such as those described above, provide accurate direct readings as long as the instrument itself is in the range of 16°C to 38°C (60°F to 100°F). The temperature of the sample has little bearing on the accuracy of the reading as the sample size is so small that it immediately assumes the temperature of the refractometer.

In winter, because outside temperatures are low, it is particularly important to keep the refractometer in the range of 16°C to 38°C (60°F to 100°F) in order to have accurate readings. Do not keep the refractometer outside. Correction factor curves for refractometer temperature variations are available from the refractometer manufacturers.

Checking the zero and calibrations. Refer to refractometer manufacturer's literature on calibration to determine method and frequency of calibration for individual refractometers.

Contamination

Contamination can generally be avoided by establishing good procedures and practices. All circumstances that permit contamination to occur cannot be listed below. However, please be aware of the following modes of contamination:

New equipment. When new equipment is placed into service, make sure that it has been cleaned. Pay particular attention to new trucks which are often shipped with an antifreeze solution in the pump and piping system. This antifreeze solution is an unwanted contaminant. Drain, rinse with water and then rinse with UCAR ENDURANCE™ EG106 ADF/AAF before putting the trucks into service.

Leaky covers. Some deicing trucks or storage tanks have covers that allow rainwater or melted snow into the tank, leading to unwanted dilution. Make sure that the tank covers of the trucks or of the storage tanks do not allow water in the tank, but remember that the tanks must be vented at all times.

Leaky tanks. Some deicing/anti-icing trucks have the anti-icing fluid tank sharing a common wall with the deicing fluid tank. Some tank walls are spot-welded (they should be seam-welded) or can develop cracks allowing deicing fluid into the anti-icing fluid or vice-versa. The presence of even a small amount of deicing fluid in the UCAR ENDURANCE EG106 ADF/AAF tank can cause significant performance problems. Make sure tanks do not leak. Some trucks have a hose containing deicing fluid that goes through the anti-icing fluid tank. Make sure that the hose and its fittings have no leaks.

Product transfers. Never transfer UCAR ENDURANCE EG106 ADF/AAF from a deicing/anti-icing truck into the UCAR ENDURANCE EG106 ADF/AAF storage tank. If there was contamination in the truck, contamination would propagate to the entire storage tank.

Dedicated equipment. Use dedicated storage and handling facilities for UCAR ENDURANCE EG106 ADF/AAF. Make sure loading and unloading lines are clean and free of contaminants.

Labeling. Conspicuously label storage tanks, loading and transfer lines, valves, deicing/anti-icing trucks, and pumps for instant identification to minimize risk of product contamination. Before transferring any fluid, check the label on both the source and receiving vessel to make sure that it is really the transfer that you intended to make. Labels for UCAR ENDURANCE EG106 ADF/AAF are available from your Dow representative.

Product mixtures. Do not mix UCAR ENDURANCE EG106 ADF/AAF with any other product. This includes, but is not limited to, UCAR Aircraft Deicing Fluid (ADF) XL54, UCAR ADF "50/50", UCAR ADF Concentrate or with any other aircraft anti-icing or deicing fluid products, runway deicing fluid, or with any other material, including, but not limited to, fuel or ethylene glycol.

Ionic contaminants. UCAR ENDURANCE EG106 ADF/AAF has substantial resistance to ionic contamination. However, large quantities of ions, particularly multi-valent ions, may affect its performance over time. See also Materials Compatibility, Galvanic Couples section, page 9.

Contamination checks. Check UCAR ENDURANCE EG106 ADF/AAF regularly to make sure that it is not contaminated (see Product Testing, pages 11-13).

[6]Available from MISCO Refractometers, Cleveland, OH. (866) 831-1999 or (216) 831-1000.
[7]Available from Reichert Technologies, Depew, NY. (888) 849-8955 or (716) 686-4500.

Application

Industry Practices and Government Regulations

Individual aircraft manufacturers provide specific anti-icing and deicing recommendations for various aircraft. Obtain and follow these specific recommendations. Understand industry aircraft deicing and anti-icing standard practices, such as those of SAE International, including Aerospace Standard 6285 for Deicing and Anti-icing Processes (AS6285) and Aerospace Recommended Practice 1971 (ARP1971) for functional requirements of deicing and anti-icing vehicles. Also follow applicable government regulations, including those of Transport Canada, the U.S. Federal Aviation Administration, the U.S. Department of Transportation, and other federal, state, provincial, and local agencies.

The application information given below is provided as general information only. The responsibility for correct application rests with the user.

Two-step Deicing/Anti-Icing

Two-step deicing/anti-icing is generally used when the aircraft is contaminated and when precipitation is active.

First step. Apply hot SAE Type I UCAR Aircraft Deicing Fluid (ADF) until all the snow, ice and frost are removed from the aircraft.

Dispense the hot UCAR ADF close to the surface to be deiced; applying from a distance results in heat loss as fluid temperature drops quickly when moving through air. Colder deicing fluids are much less effective, or even ineffective, in removing/melting frozen precipitation.

Dispense the hot UCAR ADF directly onto the total aircraft surface to be deiced. If applied only to the front part of the wing, allowing it to flow back to the aft part, the fluid will cool down significantly as it moves onto the surface of the wing, making it less effective, or even ineffective, in melting frozen contamination on the aft part of the wing.

Make sure there is no frozen precipitation remaining underneath the deicing fluid.

Apply the hot UCAR ADF in sufficient quantity so that the remaining fluid on the surface to be protected has a freezing point at least 10°C below outside air temperature (OAT). As the deicing fluid is applied, it is being diluted by the ice, snow or whatever frozen accumulation it is removing. Its freezing point is thus increased. Sufficient deicing fluid must be applied to make sure that the diluted fluids are flushed away. If you are uncertain about the concentration of the deicing fluid on the wing(s), you can determine its freezing point by checking its refractive index.

Second step. Apply the UCAR ENDURANCE™ EG106 ADF/AAF to aircraft surfaces before any refreezing occurs.

The deicing/anti-icing operation should be performed as close to takeoff as possible. “End-of-the-runway” deicing/anti-icing, performed on a designated pad adjacent to the runway, can minimize the time between deicing/anti-icing and takeoff. See Spraying UCAR ENDURANCE EG106 ADF/AAF (page 15) and Holdover Time (page 16) for additional application information.

One-Step Anti-icing

The one-step anti-icing procedure is generally used on aircraft when overnight frosting conditions are forecasted. The aircraft anti-icing fluid is applied late at night on the clean aircraft surface. Typically, UCAR ENDURANCE EG106 ADF/AAF protects an aircraft for several hours during frost conditions. Always check the aircraft surface for ice before putting aircraft into operation.

Apply unheated UCAR ENDURANCE™ EG106 ADF/AAF to an aircraft that is free of ice, snow or frost. Unheated UCAR ENDURANCE EG106 ADF/AAF is viscous and, thus, will not penetrate or melt frozen accumulation. While UCAR ENDURANCE EG106 ADF/AAF will flow off during takeoff, the ice could remain on the aircraft causing aerodynamic lift loss. Do not use unheated UCAR ENDURANCE EG106 ADF/AAF on an aircraft contaminated with any snow, ice or frost.

The one-step application is also used as a preventative measure when freezing rain is forecasted. UCAR ENDURANCE EG106 ADF/AAF will most likely be overcome by the freezing rain and deicing will be required. However, the presence of UCAR ENDURANCE EG106 ADF/AAF will make it easier (less time spent in removing the ice and less deicing fluid used) to remove the ice as the bond between the ice and the aircraft will have been made weaker.

Using UCAR ENDURANCE™ EG106 ADF/AAF in One-step Anti-icing

Caution: The application of UCAR ENDURANCE EG106 ADF/AAF, especially when used in a one-step process, may cause residues to collect in aerodynamically quiet areas, cavities, and gaps. These residues can affect flight safety (see page 6). Users should inspect aircraft as recommended in SAE AS6285. If residues are present, users should evaluate their application practices and establish an appropriate inspection and cleaning program.

Spraying UCAR ENDURANCE EG106 ADF/AAF

Pressures. The high fluid pressures and flow rates normally associated with aircraft deicing are not required for anti-icing operation and, where possible, pump speeds should be reduced accordingly. Although the operation should be optimized for each aircraft type and configuration, as well as for existing weather conditions (e.g., the wind), field experience has shown that pump outlet pressures of 45 to 70 psig generally provide a very even application.

Proper coverage. Apply a sufficient amount to completely coat the surfaces to be covered and to form a coating of typically 1 to 3 millimeters (0.04 to 0.11 inches). Insufficient coverage results in a thin layer and reduced protection. Mathematically, it takes 1 liter to cover 1 square meter with 1 millimeter; since application is never perfect, it will take at least 1 liter/square meter to achieve 1 millimeter. (In non-metric units, it will take at least 1 U.S. gallon/40 square feet to achieve 0.04 inches.)

The spray nozzle should be adjusted to give a semi-fan pattern. Let the fluid fall gently onto the surfaces to be covered. Avoid high fluid velocities (such as that used with SAE Type I deicing fluids). It is easier to have a good coverage when the nozzle is close to the surface to be covered. Close coordination of the truck driver and the sprayer in the bucket is important for trucks needing two operators.

Areas to be covered. Check with the aircraft manufacturer. Generally the surfaces to be covered include the leading edge, wing upper surface, and horizontal stabilizer. Pay particular attention to the leading edges, making sure that they have proper coverage.

Excessive application. Conversely, excess application would result in UCAR ENDURANCE EG106 ADF/AAF flowing onto the tarmac. This is wasteful and may lead to accumulations that may become messy for ground vehicles and ground crews. If there is accumulation on the tarmac, use mechanical means (e.g., vacuum trucks) to remove the fluid. Avoid the use of solid absorbents on UCAR ENDURANCE EG106 ADF/AAF unless the absorbent is to be immediately removed from the pavement.

Forced air trucks. Some trucks, which are used to spray aircraft anti-icing fluids conventionally, also have the ability to spray the fluid either injected into an airstream or sprayed on top of the airstream.

Forced air can be used as long as it is verified that the product has not been degraded and sufficient thickness has been applied. Forced air applications of UCAR ENDURANCE EG106 ADF/AAF may result in a thinner coat of fluid on the wing or an uneven application of the fluid.

Trained personnel. Use only trained personnel to apply UCAR ENDURANCE EG106 ADF/AAF safely. Personnel should be advised to read, understand, and follow the precautions listed in this bulletin, the Safety Data Sheets (SDS), and on the product label before using UCAR ENDURANCE EG106 ADF/AAF.

Holdover Time

Holdover time is the expected protection time of the anti-icing fluid under various weather conditions. The estimated protection time is the time interval between the beginning of the anti-icing operation and the failure of the fluid to protect any water on the wing from freezing. It is extremely difficult to accurately predict the protection time of an aircraft anti-icing fluid in real weather conditions. For that reason, a close check to ensure that the aircraft is free of ice, snow or frost immediately prior to takeoff, is always necessary.

Do not rely solely on holdover time charts.

Organizations such as the U.S. Federal Aviation Administration and Transport Canada publish holdover guideline tables. Such tables are guidelines only; holdover times are not absolutes. The tables are published with cautionary notes reminding potential users that holdover tables are for general information only and are to be used in conjunction with a pre-takeoff check.

Times of protection are shortened:
- in heavy weather conditions,
- by high winds,
- by jet blast, and
- by fuel temperatures lower than outside air temperature (OAT).

During precipitation, verify that the aircraft is free of ice, snow, and other frozen deposits and remains free of these deposits until “rotation” and takeoff.

Communication with Flight Crews

See Product Description, page 4.

Loss of Fluid Effectiveness

A fluid has lost its effectiveness when it is no longer able to absorb and melt precipitation. Some visual cues that a fluid has lost its effectiveness include loss of gloss, snow or ice accumulation, surface freezing, build-up of ice crystals in or on the fluid, or the presence of slush. A pre-takeoff check of the aircraft is the only way to determine if an aircraft is free of ice and snow and is safe to take off.

Product Safety

When considering the use of any Dow product in a particular application, you should review our latest Safety Data Sheet for that product and ensure that the use you intend can be accomplished safely. For Safety Data Sheets and other product safety information, contact Dow at the numbers listed on the back of this brochure. Before handling any products mentioned in the text, you should obtain available product safety information and take necessary steps to ensure that the product is used safely and that environmentally acceptable practices are followed.

Because government regulations and use conditions are subject to change, it is the user’s responsibility to determine that this information is appropriate and suitable under current, applicable laws and regulations.

The customer should furnish the information in these publications to its employees, contractors, and customers, or any other users of the product(s), and request that they do the same.

Precautions

UCAR ENDURANCE™ EG106 ADF/AAF is recommended for application on aircraft exterior surfaces only.

Do not use UCAR ENDURANCE EG106 ADF/AAF to deice or anti-ice:

- Cockpit windows
- Helicopters (unless authorized by helicopter manufacturer)
- Aircraft brake pads
- Runways
- Pavement
- Roadways
- Sidewalks
- Vehicles
- Ground support equipment

Do not spray UCAR ENDURANCE EG106 ADF/AAF directly into engines or auxiliary power units (APUs).

Do not use UCAR ENDURANCE EG106 ADF/AAF as anti-freeze for:

- Vehicles
- Ground support equipment
- Sanitary water facilities
- Aircraft or portable lavatories

Do not spray UCAR ENDURANCE EG106 ADF/AAF onto aircraft with:

- Vents open
- Pack valves open
- Baggage doors open
- Bystanders near or under plane

When using any SAE Type IV aircraft anti-icing fluid, care should be taken to note any accumulation on the runway which may lower friction values where snow accumulation occurs. This effect is dependent upon weather conditions and the amount of aircraft traffic (see Runway, Page 11).

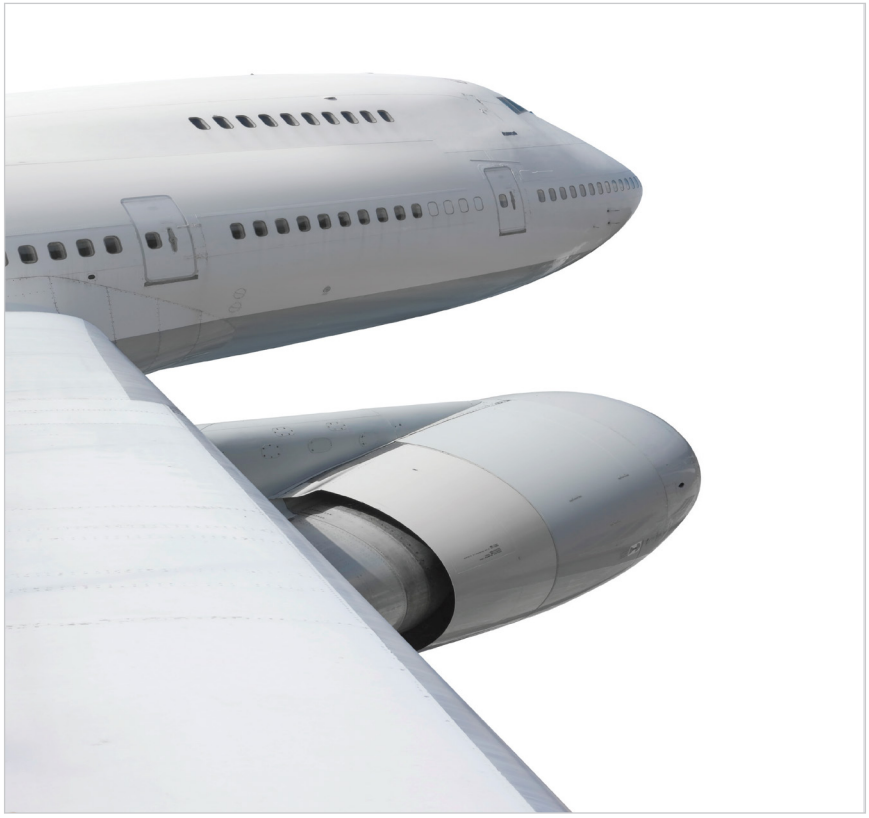
Airport operators should be aware of this potential issue. Additional airfield maintenance by timely runway sweeping and application of formate- or acetate-based runway deicing fluid to the area where the anti-icing fluid is deposited will eliminate or significantly reduce the accumulation of the anti-icing fluid.

Do not remove labels from a vessel or drum containing UCAR ENDURANCE EG106 ADF/AAF, unless they have been drained and cleaned.

Do not recycle UCAR ENDURANCE EG106 ADF/AAF.

Read the Safety Data Sheet before using this product.

For more information regarding UCAR ENDURANCE EG106 ADF/AAF, contact your Dow representative.



Emergency Service

The Chemical Manufacturers Association (CHEMTREC), Transport Canada (CANUTEC), and the National Chemistry Emergency Center maintain 24-hour emergency service.

Location	All Chemical Products
United States and Puerto Rico	Phone CHEMTREC: **(800) 424-9300** (toll-free)
Canada	Phone CANUTEC: **(613) 996-6666** (collect)
Any other location worldwide	Phone CHEMTREC (United States): **(703) 527-3887** (collect)
At sea, radio U.S. Coast Guard, who can directly contact CHEMTREC **(800) 424-9300** (toll-free)	
DO NOT WAIT. Phone if in doubt. You will be referred to a specialist for advice.	

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