AEROSPACE MATERIAL SPECIFICATION

AMS1428™	REV. L
Issued 1997-08 Revised 2023-02 Superseding AMS1428K	

Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV

RATIONALE

Sections 4.2.2 and 4.2.3 have been renumbered and revised to align with the changes made in AMS1424 to the expiration date for both initial qualification and periodic requalification. Section 3.2.3.2 was updated to replace the ASTM D2196 method for determining viscosity with AS9968 which was recently revised, references to MSDSs have been replaced with SDS, along with other editorial changes associated with renumbering and relocating 4.2.2, 4.2.3, and 4.5.1.4. Wording was added to identify the middle speed ramp as an option for aerodynamic acceptance testing, and to clarify the viscosity required for previously qualified fluids wishing to test for the mid-speed ramp. Section 3.2.5.4 was revised per the aerodynamic working group's recommendation to change the fluid elimination criteria from a percentage to a final fluid thickness.

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS1428L/

1. SCOPE

1.1 Form

This foundation specification (AMS1428L) and its associated category specifications (AMS1428/1 and AMS1428/2) cover three types of deicing/anti-icing fluids, each in the form of a non-Newtonian fluid.

1.1.1 Foundation and Category Specifications

This foundation specification establishes the requirements for all Type II, III, and IV aircraft deicing/anti-icing fluids. It defines glycol (conventional and non-conventional) based fluids and non-glycol based fluids and contains additional properties and requirements that apply to both glycol (conventional and non-conventional) and non-glycol based products.

1.1.2 Classification

Deicing/anti-icing fluids covered by this specification are classified as follows:

Table 1 - Classification

Fluid SAE Type	Anti-Icing Performance Use Table 3 (3.2.4.1)	Aerodynamic Performance Use AS5900 (see Note)	Color
Type II	II	High-speed ramp test. The low-speed and middle-speed ramp tests are optional.	Yellow
Type III	III	Either the low-speed and/or middle- speed ramp test. High-speed ramp test is optional.	Bright Yellow
Type IV	IV	High-speed ramp test. The low-speed and middle-speed ramp tests are optional.	Green

NOTE: The designations in Table 1 are for fluid classification purposes only. See 3.2.5.2 for additional information. Consult the fluid manufacturer for complete aerodynamic test data.

1.1.3 Non-Newtonian

A fluid defined as non-Newtonian exhibits a different apparent viscosity value when tested at the same temperature, using the same viscometer and spindle in a predetermined volume when the only variant is the rotational speed of the spindle. Typically, the non-Newtonian fluid shear stress is not in direct proportion to its rate of flow.

1.1.4 Pseudoplastic

A fluid described as pseudoplastic shall exhibit reduced apparent viscosity values as the spindle speed is increased and revert to original flow behavior when the shear stress is removed. This shall be demonstrable at the temperatures listed in 3.2.3.2.

1.2 Application

This document establishes the minimum requirements for the qualification of ground-based aircraft deicing/anti-icing fluids.

Refer to AS6285 for more information on the proper use or restrictions of SAE Type II, III, and IV aircraft deicing/anti-icing fluids.

1.3 Precautions

1.3.1 The lowest operational use temperature (LOUT) for a SAE Type II, III, and IV fluid shall be determined for the neat (undiluted) fluid or for each intended use dilution and is the lowest temperature at which the fluid has been tested and certified as acceptable in accordance with the appropriate aerodynamic acceptance test (3.2.5) while still maintaining the 7 °C (13 °F) freezing point temperature buffer (refer to AS6285). The fluid manufacturers' literature shall clearly state the LOUT for the neat fluid and intended use dilutions. This literature should clearly state which speed ramp test the LOUT is applicable to.

1.3.2 The deicing/anti-icing formulation may be mildly toxic and contact with human skin and eyes should be avoided. Prolonged exposure to concentrations of vapor or windborne mists should be avoided. Consult the fluid manufacturers' Safety Data Sheets for further information.

1.3.3 Caution should be exercised in the use of glycol-water deicing/anti-icing solutions in and around electrical/electronic circuitry with noble metal coated wiring or terminals which could make contact with the fluid. Exothermic reactions, which may result in fire, have been reported. This may occur where defectively insulated wires, switches, or circuit breakers carrying direct current are encountered. Fluids based on glycol shall contain an inhibitor to minimize this potential fire hazard.

1.3.4 A fluid meeting this specification is unique to each manufacturer and may be adversely affected by mixing with other aircraft deicing/anti-icing fluids.

1.3.5 Slippery conditions may exist on the ground, or equipment following the deicing/anti-icing procedure.

1.3.6 Deicing/anti-icing fluids should be compatible with carbon brake material. Refer to AS6285 and the aircraft manufacturer's maintenance and service documents for further information on fluid use. The industry standard test method for compatibility is AIR5567.

1.3.7 SAE Type II, III, and IV fluids, especially when used in a one-step process, or in the first step of a two-step process, may cause residues to collect in aerodynamically quiet areas, cavities, and gaps. These residues can affect flight safety. Refer to AS6285 for more information.

1.4 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and processes and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

1.5 Fluid Qualification

It is not sufficient for a SAE Type II, III, or IV fluid to meet all of the requirements of AMS1428 for airlines to be able to use it. For such a fluid to be used commercially, it must also have holdover time guidelines and be identified on a list of qualified fluids acceptable to regulators. For information on the qualification process of an AMS1428 fluid, refer to ARP5718.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS1428/1	Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV Glycol (Conventional and Non-Conventional) Based
AMS1428/2	Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV Non-Glycol Based
AMS2470	Anodic Treatment of Aluminum Alloys, Chromic Acid Process
AMS2475	Protective Treatments, Magnesium Alloys
AMS4037	Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn (2024; -T3 Flat Sheet, -T351 Plate), Solution Heat Treated
AMS4041	Aluminum Alloy, Sheet and Plate, Alclad, 4.4Cu - 1.5Mg - 0.60Mn (2024, -T3 Sheet/-T351 Plate with 1-1/2% Alclad), Solution Heat Treated, Cold Worked and Naturally Aged
AMS4049	Aluminum Alloy, Sheet and Plate, Alclad, 5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (Alclad 7075; -T6 Sheet - T651 Plate), Solution and Precipitation Heat Treated
AMS4376	Plate, Magnesium Alloy, 3.0Al - 1.0Zn - 0.20Mn (AZ31B-H26), Cold Rolled and Partially Annealed
AMS4911	Titanium Alloy, Sheet, Strip, and Plate, 6Al - 4V, Annealed
AMS4916	Titanium Alloy Sheet, Strip, and Plate, 8Al - 1Mo - 1V, Duplex Annealed
AMS5045	Steel, Sheet and Strip, 0.25 Carbon, Maximum, Hard Temper
AMS5886	Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings, 50Ni - 20Cr - 20Co - 5.8Mo - 2.2Ti - 0.45Al, Consumable Electrode or Vacuum Induction Melted 2100 °F (1149 °C), Solution Heat Treated
AMS-P-83310	Plastic Sheet, Polycarbonate, Transparent
ARP1917	Clarification of Terms Used in Aerospace Metals Specifications
ARP5485	Endurance Time Test Procedures for SAE Type II/III/IV Aircraft Deicing/Anti-Icing Fluids
ARP5718	Qualifications Required for SAE Type II/III/IV Aircraft Deicing/Anti-Icing Fluid
AS5900	Standard Test Method for Aerodynamic Acceptance of AMS1424 and AMS1428 Aircraft Deicing/Anti-Icing Fluids
AS5901	Water Spray and High Humidity Endurance Test Methods for AMS1424 and AMS1428 Aircraft Deicing/Anti-Icing Fluids
AS6285	Aircraft Ground Deicing/Anti-Icing Processes
AS9968	Laboratory Viscosity Measurement of Thickened Aircraft Deicing/Anti-icing Fluids with the Brookfield LV Viscometer

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM C672 Scaling Resistance of Concrete Surfaces Exposed to De-Icing Chemicals

ASTM D93 Flash Point by Pensky-Martens Closed Cup Tester

ASTM D891 Specific Gravity, Apparent, of Liquid Industrial Chemicals

ASTM D1177 Freezing Point of Aqueous Engine Coolants

ASTM D1193 Reagent Water

ASTM D1331 Surface and Interfacial Tension of Solutions of Surface-Active Agents

ASTM D1568 Sampling and Chemical Analysis of Alkylbenzene Sulfonates

ASTM D1747 Refractive Index of Viscous Materials

ASTM D3278 Flash Point of Liquids by Small Scale Closed Cup Apparatus

ASTM D4052 Density and Relative Density of Liquids by Digital Density Meter

ASTM D4177 Automatic Sampling of Petroleum and Petroleum Products

ASTM E70 pH of Aqueous Solutions with the Glass Electrode

ASTM F483 Total Immersion Corrosion Test for Aircraft Maintenance Chemicals

ASTM F484 Stress Crazing of Acrylic Plastics in Contact with Liquid or Semi-Liquid Compounds

ASTM F485 Effects of Cleaners on Unpainted Aircraft Surfaces

ASTM F502 Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces

ASTM F519 Mechanical Hydrogen Embrittlement Evaluation of Plating Processes and Service Environments

ASTM F945 Stress Corrosion of Titanium Alloys by Aircraft Engine Cleaning Materials

ASTM F1105 Preparing Aircraft Cleaning Compounds, Liquid Type, Temperature-Sensitive, or Solvent-Based, for Storage Stability Testing

ASTM F1110 Sandwich Corrosion Test

ASTM F1111 Corrosion of Low-Embrittling Cadmium Plate by Aircraft Maintenance Chemicals

2.3 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

MIL-PRF-25690 Plastic, Sheets and Formed Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant

MIL-STD-870 Cadmium Plating, Low Embrittlement, Electrodeposited

2.4 APHA Publications

Available from American Public Health Association, 1015 Fifteenth Street, NW, Washington, DC 20005, or www.apha.org.

Standard Methods for the Examination of Water and Waste Water

2.5 OECD Publications

Available from OECD, 2, rue André Pascal, Cedex 16, 75016 Paris, France, or www.oecd.org.

OECD Guidelines for Testing Chemicals

3. TECHNICAL REQUIREMENTS

3.1 Material

The composition of the fluid shall be optional to the manufacturer and shall be based on freezing point depressants with additives, such that the finished product shall meet the requirements of this specification.

3.1.1 Definition of Glycol (Conventional and Non-Conventional) and Non-Glycol

For the purpose of classification for AMS1428 aircraft deicing/anti-icing fluids, freezing point depressants used to formulate AMS1428L Type II, III, and IV deicing/anti-icing fluids are classified as “glycol (conventional and non-conventional)” and “non-glycol” based fluids.

3.1.1.1 Glycol (conventional) is defined as ethylene glycol, diethylene glycol, or propylene glycol.

3.1.1.2 Glycol (non-conventional) is defined as organic non-ionic diols and triols, e.g., 1,3-propanediol, glycerine, and mixtures thereof, and mixtures with glycol (conventional).

3.1.1.3 Non-glycol is defined as all that is not glycol (conventional and non-conventional), such as organic salts, e.g., sodium formate, sodium acetate, potassium formate, potassium acetate, and any mixtures thereof. Mixtures of glycol (conventional and non-conventional) and non-glycol are defined as non-glycol.

3.1.2 Requirements

3.1.2.1 Glycol (conventional and non-conventional) based fluids shall meet all technical requirements of this specification, except 3.1.3.

3.1.2.2 Non-glycol based fluids shall meet all the requirements of this specification, including 3.1.3.

3.1.3 Non-Glycol Based Fluid

A fluid based on non-glycol freezing point depressants shall be tested as follows:

Two pieces of AMS5886 bar, 35 mm diameter and 15 mm long, shall have one end of each machined flat. An 8.5 mm drill shall then be used to drill a centered hole 6.5 mm deep in one end to allow the milling of a cup shaped depression. A 12.5 mm bull nosed end mill shall be used to open up the drilled hole to produce a 7 mm deep depression. The cup shall then be finished by improving the surface with 600 µm, 180 µm, and 6 µm diamond paste. The cups shall be cleaned and degreased using a suitable solvent and allowed to dry. One cup shall be filled with the candidate test fluid, the other with water conforming to ASTM D1193 Type IV, both test pieces shall then be placed in an oven at 105 °C ± 2 °C (221 °F ± 4 °F). The fluid shall then be allowed to evaporate by progressive increase in oven temperature at the rate of 10 °C (18 °F) per minute to a final temperature of 250 °C ± 5 °C (482 °F ± 9 °F), where they shall be maintained for 15 minutes ± 1 minute. Test pieces shall then be transferred to an air furnace set at 1040 °C ± 10 °C (1904 °F ± 18 °F) and maintained for 2 hours ± 5 minutes.

Test pieces shall be removed and allowed to cool to ambient temperature. Microscopic examination of the polished cups at 500X shall be undertaken. No corrosion worse than that of the control cup shall be evident in the candidate test fluid cup.

The report shall include photographs of both cups after testing and the candidate test fluid cup shall be identified.

3.1.4 Toxicity

The user shall ensure that the fluid meets all local, state, and/or federal toxicity regulations. The information to satisfy the federal, state, and provincial requirements shall be provided by the manufacturer, and for local requirements, upon request, from the user.

3.1.5 Appearance

The fluid, as received by purchaser, shall be homogeneous, uniform in color, and free from skins, lumps, and foreign materials which would be detrimental to usage of the product. The fluid may be clear or cloudy, as described by the manufacturer. The fluid shall be colored according to Table 1.

3.1.6 Environmental Information

Formulated fluid shall be tested in accordance with APHA “Standard Methods for the Examination of Water and Waste Water.” The following tests shall be performed and the results reported:

3.1.6.1 Biochemical Oxygen Demand (BOD)

The fluid shall be incubated at 20 °C (68 °F) for 5 days, 15 days, 20 days, or 28 days, dependent upon the method chosen, and the BOD determined.

3.1.6.2 Total Oxygen Demand (TOD) or Chemical Oxygen Demand (COD)

The TOD or COD of the fluid, expressed in kilograms of oxygen per kilogram of fluid, shall be determined.

3.1.6.3 Biodegradability

This characteristic can be approximated by determining the ratio of BOD to TOD or COD. The percent of fluid biodegraded can be calculated by dividing BOD by TOD or COD and shall be reported for the incubation time periods specified in the chosen test method.

3.1.6.4 Aquatic Toxicity

The fluid shall be tested in accordance with EPA 40 CFR 797.1300 and 794.14, revised July 1, 1989, or OECD (Organization for Economic Cooperation and Development Guidelines for Testing of Chemicals), methods 202 and 203, using test species required by regulatory agencies for permitted discharges. Examples include fathead minnows, daphnia magna, and rainbow trout. The LC50 concentration (the highest concentration at which 50% of the organisms do not survive the test period) shall be stated in mg per L.

3.1.7 Trace Contaminants

Report the presence, in percentages by weight or parts per million by weight, of sulfur, halogens, phosphate, nitrate, and heavy metals (lead, chromium, cadmium, and mercury). Report the test method used and detection limits.

3.2 Physical Properties

The fluid shall conform to the following requirements; tests shall be performed in accordance with the specified test methods.

3.2.1 Fluid as Received in Neat Form

3.2.1.1 Flash Point

Shall be not lower than 100 °C (212 °F) determined in accordance with ASTM D93 or ASTM D3278. In case of dispute, the flash point determined in accordance with ASTM D93 shall apply.

3.2.1.2 Specific Gravity

Specific gravity shall be determined in accordance with ASTM D891 or ASTM D4052 and the results reported. Results for periodic requalification or quality control testing shall be within ±0.015 of the fluid's initial qualification value.

3.2.1.3 pH

The pH shall be determined in accordance with ASTM E70 and the results reported.

Results for periodic requalification or quality control testing shall be within ±0.5 unit of the fluid's initial qualification value.

3.2.1.4 Refractive Index

Refractive index shall be determined in accordance with ASTM D1747 and the results reported.

Results for periodic requalification or quality control testing shall be within ±0.0015 of the fluid's initial qualification value.

3.2.1.5 Surface Tension

Surface tension shall be determined in accordance with ASTM D1331 and the results reported.

Results for periodic requalification or quality control testing shall be within ±10% of the fluid's initial qualification value at 20 °C ± 2 °C (68 °F ± 4 °F).

3.2.2 Fluid Stability

3.2.2.1 Thermal Stability-Accelerated Aging (to simulate long-term heated storage without water loss)

Age sample as in 3.2.2.1.1 and examine as in 3.2.2.1.2.

3.2.2.1.1 Transfer 800 mL ± 10 mL of fluid to a 1 L borosilicate bottle (e.g., Pyrex® brand or equivalent) fitted with a tight, heat-resistant plastic seal and tightly close. For the reference sample, also keep 800 mL ± 10 mL of the fluid in an identical bottle and store at room temperature until the completion of 3.2.2.1.2. Transfer the other closed bottle containing the test fluid to a circulating-air oven or heated oil or water bath. Elevate the temperature to 70 °C ± 2 °C (158 °F ± 4 °F) and maintain the test sample in this environment for 30 days.

3.2.2.1.2 After 30 days, remove the test sample from the heated environment and examine the contents for evidence of separation, precipitation, or insoluble deposits. Report any evidence of these factors. Allow the test sample to cool to 20 °C ± 2 °C (68 °F ± 4 °F). Turn the test sample bottle upside down and then right side up. Repeat this rotation procedure three additional times, and then examine the contents for evidence of separation, precipitation, or insoluble deposits versus the unheated reference sample. Report findings. Determine the refractive index of the test and reference samples as in 3.2.1.4. If the test and reference samples have a refractive index difference of greater than 0.0020, the test is invalid.

If the test is valid, measure viscosity at 0 °C ± 2 °C (32 °F ± 4 °F) as in 3.2.3.2.1 using a spindle speed of 0.3 rpm, and pH as in 3.2.1.3. Compare and record the results of the heat-aged test sample and the unheated reference sample. The viscosity shall neither be reduced by more than 20% nor be increased by more than 10%. The pH difference shall not be greater than 1.0 unit. The heat-aged test sample shall be tested according to AS5901 (WSET only) using one set of three plates. Report the results of the test.

3.2.2.2 Exposure to Dry Air (to simulate fluid behavior following overnight exposure to dry air)

The fluid shall be tested in accordance with 3.2.2.2.1. If the fluid, after losing 20% of its original weight, exceeds the viscosity limit defined in 3.2.2.2.1, the fluid shall then be tested in accordance with 3.2.2.2.2 to determine the percent weight loss and aerodynamic performance after exposure to a simulated dry air environment. Results from successive dry out and rehydration (3.2.2.4) tests should also be reviewed to ensure that any fluid that fails to meet the viscosity limit defined in 3.2.2.2.1 will not result in high levels of dried residue and/or gel formation.

3.2.2.2.1 The fluid, after exposure to a dry air environment which results in weight reduction of 20% ± 1%, shall have a viscosity not exceeding 500 mPa·s when measured at 3.0 rpm and with spindle LV1 with sample at 20 °C ± 2 °C (68 °F ± 4 °F) using the method described in 3.2.3.2.1.

3.2.2.2.1.1 Pour approximately 800 mL of fluid into a pre-weighed glass tray with the following approximate dimensions 200 x 200 x 50 mm. Weigh the tray and contents to the nearest 2 g, record the weight. Place this tray with its contents into an environment with air temperature at 23 °C ± 3 °C (73 °F ± 6 °F) and the relative humidity not greater than 50% and preferably in the 30 to 45% range. Periodically weigh the tray and contents. When the weight of the fluid is 20% ± 1% lower than its initial weight, pour 500 mL ± 10 mL of the fluid into a 600 mL beaker. Allow to cool to 20 °C ± 2 °C (68 °F ± 4 °F) and test for viscosity.

3.2.2.2.2 The fluid shall be tested to determine the percent weight loss obtained under simulated conditions defined in 3.2.2.2.2.1. Fluid at this percent weight loss shall meet aerodynamic performance requirements in accordance with AS5900 by performing three runs of the aerodynamic acceptance test (3.2.5.2) at -5 °C ± 2 °C (23 °F ± 4 °F), and speed ramp(s) used for preproduction tests of the neat fluid.

3.2.2.2.2.1 Place a 1 mm layer of fluid into a pre-weighed Petri dish cover with the approximate dimensions of 10 cm diameter x 5 mm height. Record the weight to the nearest 0.02 g. Place the Petri dish into a 55% ± 2% relative humidity environment with air temperature at 0 °C ± 2 °C (32 °F ± 4 °F) and 4 m/s ± 0.5 m/s horizontal air velocity for 12 hours ± 0.2 hour. Equilibrate the dish and its contents to 20 °C ± 2 °C (68 °F ± 4 °F) and record the final weight. The percent weight loss shall be reported from an average of at least three Petri dish tests.

3.2.2.2.2.2 Additional fluid at the percent weight loss obtained under the simulated conditions (±1 wt%) in 3.2.2.2.2.1 can be prepared at room temperature in pans under a fume hood to make the quantity required for aerodynamic testing.

3.2.2.3 Dry-Out by Exposure to Cold Dry Air (to simulate fluid dry-out in cold air on the ramp and on the aircraft including aerodynamically quiet areas)

Test as per 3.2.2.3.1 and 3.2.2.3.2.

3.2.2.3.1 Using a cold chamber, position three plates, inclined at an angle of 2 degrees from the horizontal. Pour 100 to 150 mL of fluid on each plate. Set the air and plate temperatures at 1 °C ± 1 °C (34 °F ± 2 °F). Relative humidity less than 40%, and the air moving from the top over the surface towards the bottom of the plates at approximately 2.5 m/s (5.6 mph). Maintain these conditions until the fluid has dried or for 24 hours. Examine the remaining residues. A gel, gum (tacky feel), hard granular solid, or peelable film are not acceptable.

3.2.2.3.2 Remove the plates from cold chamber and allow them to warm to 5 °C ± 2 °C (41 °F ± 4 °F) and rinse each plate with 500 mL water, conforming to ASTM D1193 Type IV, at 15 °C ± 10 °C (59 °F ± 18 °F) from a 1 L squeeze bottle. Report the appearance of the plates after rinsing. Only plates free of residue are acceptable. After rinsing, allow the plates to dry at room temperature. Report the appearance of the plates after drying.

3.2.2.4 Successive Dry Out and Rehydration (to simulate the formation of dried residues and for such to form gels upon rehydration)

Fluid shall be tested in accordance with Appendix A and results reported. The weight on rehydration for all ten dips must not be greater than 4 g.

3.2.2.5 Thin Film Thermal Stability (to simulate heated leading edge dry out to demonstrate that a dried-out fluid does not have certain undesirable texture/qualities; such a dried-out fluid will not provide holdover time)

Test as per 3.2.2.5.1, 3.2.2.5.2, and 3.2.2.5.3.

3.2.2.5.1 At ambient temperature, pour 40 to 50 mL of the fluid on to each of two unpainted aluminum or aluminum alloy test panels, approximately 152.5 x 50 mm (6 x 2 inches). After 5 minutes, place the panels, inclined at an angle of 10 degrees from the horizontal, in an oven maintained at 95 °C ± 2 °C (203 °F ± 4 °F). After 60 minutes ± 1 minute, remove the panels, allow them to cool to ambient temperature, and inspect. Report the appearance. A gel, gum (tacky feel), hard granular solid, or peel-able film are not acceptable.

3.2.2.5.2 Rinse each plate with 500 mL water conforming to ASTM D1193 Type IV at 15 °C ± 10 °C (59 °F ± 18 °F) from a 1 L squeeze bottle positioned not closer than 20 cm from the surface. Report the appearance of the plates after rinsing. Only plates free of residue are acceptable. After rinsing, allow the plates to dry at room temperature. Report the appearance of the plates after drying.

3.2.2.5.3 Repeat test as in 3.2.2.5.1 and 3.2.2.5.2 except that the oven temperature shall be at 48 °C ± 2 °C (118 °F ± 4 °F). Report results of both tests.

3.2.2.6 Storage Stability (to simulate storage in tanks)

Prior to the start of this test, the viscosity shall be determined at 20 °C ± 2 °C (68 °F ± 4 °F), in accordance with 3.2.3.2.1. The fluid shall be tested in accordance with ASTM F1105, except that the sample shall be protected from exposure to UV light. Upon completion of the test, the fluid shall be retested for viscosity as before and the result compared to the original values. Both results shall fall within the limits determined in 3.2.3.3.

3.2.2.7 Shear Stability

The anti-icing performance tests as in 3.2.4 shall start within 2 hours after the product has been sheared, but not within the first 20 minutes after shearing using the laboratory method as in 3.2.2.7.1.

3.2.2.7.1 Run a laboratory blender (Waring model number 7012G or equivalent) with the 1 L glass mixing container removed for a 5 minute warming period at 3000 rpm ± 100 rpm. Pour 500 mL ± 5 mL of fluid at 20 °C ± 2 °C (68 °F ± 4 °F) into the 1 L mixing container. Mix for 5 minutes ± 10 seconds at 2000 rpm. The blender shall be calibrated using a non-contact optical tachometer to provide a mix speed of 2000 rpm ± 100 rpm using 500 mL of water. This non-contact calibration can be performed by placing the blender on a stand and elongating the rotating shaft at the base to measure the rotation speed with the mixing container in place.

3.2.2.8 Hard Water Stability

The fluid diluted 1:1 by volume with standard hard water made up as in 3.2.2.8.1 and aged as in 3.2.2.8.2, shall show no evidence of insoluble deposits after inversion, and the pH shall not vary by more than ±1.0 unit from an unheated reference sample. If the refractive index has increased by more than 0.0020 at 20 °C ± 2 °C (68 °F ± 4 °F) from the reference sample, the test is invalid as water has been allowed to evaporate during the test. A sample of the diluted test fluid, after hard water stability testing, shall be tested in accordance with AS5901 (WSET only) using one set of three plates, and the results reported.

3.2.2.8.1 Composition of Hard Water

Dissolve 400 mg ± 5 mg calcium acetate dehydrate ($Ca[C_2H_3O_2]_2 \cdot 2H_2O$) or 363 mg ± 5 mg calcium acetate monohydrate ($Ca(C_2H_3O_2)_2 \cdot H_2O$) and 280 mg ± 5 mg magnesium sulfate heptahydrate ($MgSO_4 \cdot 7H_2O$), both of analytical reagent quality, in 1 L of ASTM D1193, Type IV, water.

3.2.2.8.2 Place 800 mL ± 10 mL of the diluted fluid into a 1 L borosilicate bottle (e.g., Pyrex® brand or equivalent) fitted with a tight, heat-resistant plastic seal and tightly close. For the reference sample, also keep 800 mL ± 10 mL of diluted fluid in an identical bottle and store at room temperature until the completion of 3.2.2.8.3. Transfer the other closed bottle containing the diluted test fluid to a circulating-air oven or heated oil or water bath. Elevate the temperature to 95 °C ± 2 °C (203 °F ± 4 °F) and maintain the diluted test sample in this environment for 30 days.

3.2.2.8.3 After 30 days, remove the diluted test sample from the heated environment and allow it to cool to 20 °C ± 2 °C (68 °F ± 4 °F). Examine the contents for evidence of separation, precipitation, or insoluble deposits versus the unheated reference sample. Report findings. Turn the test sample bottle upside down and then right side up. Repeat this rotation procedure three additional times. Inspect as in 3.2.2.8.

3.2.2.9 Tendency to Foam

At the option of the user, the vendor shall demonstrate that fluid as supplied or in intended use dilutions and heated to intended use temperatures, applied through commercial deicing/anti-icing vehicle systems to an inclined flat or curved surface, preferably an aircraft wing or horizontal stabilizer, at pressures and flow rates normal for the intended use, does not cause foam which does not rapidly collapse, and fluid surface shall not have the appearance of snow or slush.

3.2.2.10 Cold Storage Stability (to simulate the stability of the fluid cycling between cold temperature and room temperature)

Prior to the start of this test, the sample shall be visually examined to determine freedom from insoluble deposits. Report any evidence of these factors. Determine the pH in accordance with 3.2.1.3. Determine the refractive index in accordance with 3.2.1.4. Determine the viscosity in accordance with 3.2.3.2.1, Values shall be taken at a spindle speed of 0.3 rpm at 20 °C ± 2 °C (68 °F ± 4 °F). The report shall clearly state the size and type of spindle used.

3.2.2.10.1 Transfer 2.0 L of fluid into an appropriate 2.5 L container (e.g., high-density polyethylene-HDPE, glass separatory funnel, etc.) with a well-closed cap. Transfer the closed container containing the sample of fluid to a freezer. Maintain the sample at -20 °C ± 2 °C (-4 °F ± 4 °F) for 24 hours. After 24 hours, remove the closed container containing the fluid sample from the freezer. Allow the sample to stand at 20 °C ± 2 °C (68 °F ± 4 °F) for 24 hours. Repeat the cycling between -20 °C and 20 °C for five complete cycles. An example of the cycling period is shown in Table 2.

Table 2 - Fluid cycling period

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
-20 °C	20 °C	-20 °C	20 °C	-20 °C	20 °C	-20 °C	20 °C	-20 °C	20 °C

3.2.2.10.2 Upon completion of the cycling, the fluid shall be visually examined for evidence of separation, precipitation, or insoluble deposits. Report any visual observations. Allow fluid to equilibrate to room temperature. Siphon/extract 1 L from the top portion of the fluid sample, ensuring that the tip of the siphon hose remains 2 inches beneath the surface of the fluid, and transfer the top portion into a separate container (labeled top). Siphon/extract 1 L from the bottom portion, ensuring that the tip of the siphon hose remains at the bottom of the container, and transfer the bottom portion into a separate container (labeled bottom). The top and bottom portions of the fluid sample shall be retested as before for pH, refractive index, and viscosity in accordance with 3.2.2.10 and the results compared to the original values.

3.2.3 Rheological Properties

The special rheological properties defined in 3.2.3.1 and 3.2.3.2 relate to thickened fluids which are classed as non-Newtonian, pseudoplastic as defined in 1.1.2 and 1.1.3, and are specified to ensure the flow of the film when sufficient shear stress is induced. The exposure of a film of the applied fluid to different environmental factors shall not impair this performance (either by buildup of film thickness due to consecutive applications or by forming a gel), when tested in accordance with 3.2.2.2 and 3.2.2.3. Fluids of all types shall be tested as in 3.2.3.2.

3.2.3.1 Viscosity

The fluid shall exhibit non-Newtonian flow behavior over the temperature range at which the fluid has been tested and certified as acceptable in accordance with the Aerodynamic Acceptance test (3.2.5). The viscosity of any neat fluid as supplied shall be measured as per 3.2.3.2 and fall within the limits defined in 3.2.3.3.

3.2.3.2 Viscosity Measurement

The viscosity shall be measured at 0.3 rpm, 6 rpm, and 30 rpm at 20 °C ± 2 °C (68 °F ± 4 °F), 0 °C ± 2 °C (32 °F ± 4 °F) and in 10 °C (18 °F) increments down to the lowest usable temperature identified by the manufacturer for all applicable aerodynamic speed ramps tested.

3.2.3.2.1 The viscosity shall be measured and reported in accordance with AS9968. Unless otherwise stated within this document, the Manufacturer's recommended test parameters or the test parameters described within AS9968 shall be used. In case of dispute, the Manufacturer's test parameters shall be used only if they meet minimum limits for precision and accuracy established for the fluid using the methods described in AS9968.

3.2.3.3 Viscosity Limits

The viscosity of any neat fluid as supplied shall fall within the limits of the high and low viscosity values defined by the initial qualification samples (4.2.2) and the viscosity limits shall be reported. For quality control purposes the manufacturer shall specify the typical viscosity range a user can expect to obtain from fluid being delivered for use.

3.2.4 Anti-Icing Performance

3.2.4.1 Water Spray Endurance Test (WSET) and High Humidity Endurance Test (HHET)

When tested in accordance with AS5901, the neat fluid, sheared as in 3.2.2.7, shall form a film which will protect against the formation of frozen deposits within the failure zone depicted in Figure 1 of AS5901 for the times listed in Table 3. Similarly, if the fluid is intended to be diluted with water, it shall be diluted by volume to ratios of 75:25 and 50:50 with water conforming to 3.2.2.8.1 and sheared as in 3.2.2.7 and shall protect as in Table 3. Confirmation shall be obtained from six panels, three panels from each of two successive test runs.

Table 3 - Minimum anti-icing performance

Fluid - SAE Type and Dilution	WSET Time - Minutes	HHET Time - Hours
II 100:00	30	4
75:25	20	2
50:50	5	0.5
III 100:00	20	2
75:25	Determine and report	Determine and report
50:50	Determine and report	Determine and report
IV 100:00	80	8
75:25	20	2
50:50	5	0.5

3.2.5 Aerodynamic Acceptance

3.2.5.1 Criterion to Shear or Not to Shear the Fluid

If after shearing in accordance with 3.2.2.7.1, the apparent viscosity increases by more than 15% when tested in accordance with 3.2.3.2.1 at 0 °C ± 2 °C (32 °F ± 4 °F) at spindle speeds of 6 rpm and 30 rpm, the fluid shall be sheared prior to testing. If the apparent viscosity increased by less than or equal to 15%, or decreased, the fluid shall be tested in the unsheared state.

3.2.5.2 Aerodynamic Test

Fluid shall be tested to one or more of the three speed ramp tests listed in AS5900, as described in Table 1, and must demonstrate acceptable aerodynamic performance for a specific speed ramp test in order to be approved to be used on the corresponding class of aircraft:

The high-speed ramp test is the approved aerodynamic test for fluids used on large transport type aircraft, defined as aircraft with takeoff rotation speeds exceeding 100 kts, with time from brake release to rotation speed greater than 20 seconds and time to lift-off greater than approximately 25 seconds.

The low-speed ramp test is the approved aerodynamic test for fluids used on lower takeoff rotation speed commuter aircraft, defined as aircraft with takeoff rotation speeds between 60 to 100 kts, with time from brake release to rotation speed between 15 to 20 seconds.

The middle-speed ramp test was developed to provide additional operational capability for aircraft such as regional turboprops with lower rotational speeds than large transport type aircraft, defined as aircraft with takeoff rotation speeds between 80 kts and 100 kts, with time from brake release to rotation speed between 16 to 20 seconds.

A fluid and its volume/volume dilutions (defined in Table 3) shall be tested at temperatures ranging from 0 °C ± 2 °C (32 °F ± 4 °F) down to the lowest temperature requested by the fluid manufacturer, in approximately 10 °C (18 °F) intervals. For each fluid or dilution, a minimum of three tests shall be performed at each temperature.

For complete aerodynamic data, consult the fluid manufacturer.

3.2.5.3 Test with the Highest Viscosity Dilution

For the initial qualification sample, the dilution ratios which produce high viscosity at different temperature intervals shall be identified. Each dilution which exhibits a viscosity greater than that of the neat, 75:25 or 50:50 dilution, by more than 15% at each temperature interval, shall demonstrate acceptable aerodynamic performance when tested in accordance with AS5900 as described in 3.2.5.3.1.

3.2.5.3.1 Prepare dilutions of the fluid in 5% volume increments using water conforming to ASTM D1193 Type IV. The viscosity shall be measured according to 3.2.3.2.1 at 6 rpm and 30 rpm using the small sample adapter and appropriate spindle at 0 °C ± 2 °C (32 °F ± 4 °F), -10 °C ± 2 °C (14 °F ± 4 °F), and -20 °C ± 2 °C (-4 °F ± 4 °F). Measurements shall be made on dilutions with increasing water content until three consecutive decreasing viscosity measurements are obtained. Each dilution which exhibits a viscosity greater than that of the neat, 75:25 or 50:50 dilution, by more than 15% at each temperature interval, shall be identified. Each of these identified dilutions shall be tested in accordance with AS5900 by performing three runs at the respective temperature interval, and speed ramp(s) used for preproduction tests of the neat fluid.

3.2.5.4 Fluid Elimination

Fluid elimination shall be measured and averaged in accordance with AS5900 and shall be based on a targeted initial thickness of 2 mm (2000 µm) of fluid on the test duct floor.

The final fluid thickness shall not be greater than 0.52 mm (520 µm) at all tested temperatures for the high-speed ramp test and the middle-speed ramp test.

The final fluid thickness shall not be greater than 0.86 mm (860 µm) at all tested temperatures for the low-speed ramp test.

3.3 Fluid Tested Both Neat and as a Diluted Solution

Tests shall be conducted using the neat fluid and using a solution comprised of the neat fluid diluted 1:1 by weight with ASTM D1193, Type IV, water.

3.3.1 Freezing Point

For the neat fluid, the freezing point shall be not higher than -32 °C (-26 °F). When diluted at a ratio of 1:1 by weight with ASTM D1193, Type IV, water, the freezing point shall be not higher than -10 °C (+14 °F), determined in accordance with ASTM D1177. Report freezing points for both the neat and 1:1 diluted fluid.

3.3.2 Effect on Aircraft Materials

3.3.2.1 Sandwich Corrosion

Specimens, after testing in accordance with ASTM F1110, shall not have a rating greater (worse) than 1.

3.3.2.2 Total Immersion Corrosion

The fluid, tested in accordance with ASTM F483, shall neither produce evidence of corrosion of test panels nor cause a weight change of any test panel greater than shown in Table 4.

Table 4 - Total immersion corrosion

Test Panel	Weight Change mg/cm^2 per 24 hours
AMS4037 Aluminum Alloy, anodized as in AMS2470	0.3
AMS4041 Aluminum Alloy	0.3
AMS4049 Aluminum Alloy	0.3
AMS4376 Magnesium Alloy, dichromate treated as in AMS2475	0.2
AMS4911 or MAM4911 Titanium Alloy	0.1
AMS5045 Carbon Steel	0.8

3.3.2.3 Low-Embrittling Cadmium Plate

Test panels, coated with low-embrittling cadmium plate, shall not show a weight change greater than 0.3 mg/cm^2 per 24 hours, determined in accordance with ASTM F1111 (see 3.3.2).

3.3.2.4 Stress-Corrosion Resistance

The fluid shall not cause cracks in AMS4911 titanium specimens when tested in accordance with ASTM F945, Method A.

3.3.2.4.1 Stress Corrosion Resistance

The fluid shall be tested in accordance with ASTM F945, Method A, using AMS4916 specimens. The test report shall detail the effects of the fluid and of the control solution.

3.3.2.5 Hydrogen Embrittlement

The fluid shall be non-embrittling, determined in accordance with ASTM F519, utilizing Type 1a, 1c, or 2a specimens, cadmium plated in accordance with MIL-STD-870, Class 1, Type I. In case of dispute, the Type 1c bar shall be used. Type 1a and 1c specimens shall be loaded to 45% of the predetermined notch fracture strength, and Type 2a specimens loaded to 80% of the yield strength. The entire 2a stressed specimen, or just the notched area of the 1a and 1c stressed specimen, shall be immersed continuously in the fluid under test for 150 hours at a temperature of 25 °C ± 5 °C (77 °F ± 9 °F). The test specimens shall be galvanically isolated. Galvanic reactions can be prevented by confining the test sample to the test specimen using a chemically inert cup (see 3.3.2).

3.3.2.6 Effect on Transparent Plastics

When heated to 65 °C ± 2 °C (149 °F ± 4 °F), the fluid shall not craze, stain, or discolor MIL-PRF-25690 stretched acrylic plastic, determined in accordance with ASTM F484.

3.3.2.6.1 Similarly, fluid shall not craze, stain, nor discolor AMS-P-83310 polycarbonate plastic, determined in accordance with procedures in ASTM F484 except that the specimens shall be stressed for 30 minutes ± 1 minute to an outer fiber stress level of 13.8 MPa (2000 psi).

3.3.3 Effect on Painted Surfaces

When heated to 65 °C ± 2 °C (149 °F ± 4 °F) and applied to a painted surface having an initial surface temperature of 22 °C ± 2 °C (72 °F ± 4 °F), the fluid shall not produce any streaking, discoloration, or blistering of the paint film, and shall not decrease paint film hardness by more than two pencil hardness numbers, determined in accordance with ASTM F502.

3.3.4 Effect on Unpainted Surfaces

The fluid tested in accordance with ASTM F485, shall neither produce streaking nor leave any stains, which require polishing to remove.

3.3.5 Pavement Compatibility

3.3.5.1 Runway Concrete Scaling Resistance

The condition of the runway concrete surface shall have a rating not greater than 1 for 50 freeze-thaw cycles, determined in accordance with ASTM C672, except that the concrete shall be air-entrained with an air content as in ASTM C672, have a minimum cement content of 302 kg/m^3 ± 4.5 kg/m^3 (510 lb/yd^3 ± 10 lb/yd^3) and a slump, 38 mm ± 13 mm (1.5 inches ± 0.5 inch). A 25% ± 1% by volume solution of the neat fluid prepared using tap water shall be substituted for the specified calcium chloride. Performing more than one freeze thaw cycle per day is acceptable.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of the fluid shall supply all samples for conformance testing and shall be responsible for obtaining independent laboratory confirmation of conformance to the requirements of this specification. Each fluid sample container shall be clearly identified with the vendor's name, fluid name or code number and lot number, and manufacturing site address. The purchaser or user reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the fluid conforms to the requirements of this specification.

4.2 Classification of Tests

4.2.1 Lot Acceptance Tests

The pH (3.2.1.3), refractive index (3.2.1.4), and viscosity at 20 °C ± 2 °C (68 °F ± 4 °F) or 0 °C ± 2 °C (32 °F ± 4 °F) at 0.3 rpm, 6 rpm, and 30 rpm are acceptance tests and shall be performed on each lot. The Certificate of Analysis for a production lot shall contain the results of these tests.

4.2.2 Initial Qualification Tests

Two fluid samples shall be submitted and tested in accordance with 4.2.2.1 and 4.2.2.2. Tests shall be performed prior to, or upon the initial shipment of, the fluid to a purchaser (except for storage stability (3.2.2.6), which may be waived by the purchaser to permit entry of a new product), when a change in any ingredient or production method requires re-approval as in 4.4.2, and when the purchaser deems confirmatory testing to be required.

Expiration dates of anti-icing performance (3.2.4) and aerodynamic acceptance (3.2.5) initial qualification tests will be as follows:

- Tests performed between January 1st and May 31st: June 1st two calendar years after the performance of the test (e.g., test performed March 15, 2019 will expire on June 1, 2021).
- Tests performed between June 1st and December 31st: Two calendar years after the performance of the test (e.g., test performed August 15, 2019 will expire August 15, 2021).

These dates have been chosen (a) to facilitate timely publication of initial qualification test data, and (b) to avoid a backlog at the test lab. Manufacturers are encouraged to submit samples early in the year to assist the test lab and regulators meet these objectives.

4.2.2.1 High Viscosity Initial Qualification Sample

Tests for all technical requirements shall be performed on the high viscosity sample. The high viscosity sample shall define the maximum viscosity that complies with the aerodynamic acceptance test (3.2.5). This viscosity value will be reported as the maximum on-wing viscosity of the fluid.

If qualifying the fluid at an additional ramp speed at a later date than the initial aerodynamic qualification test(s), the viscosity of the fluid sample being used must be equal to or greater than the reported viscosity of the original high viscosity sample that was used for the initial aerodynamic acceptance test(s).

4.2.2.2 Low Viscosity Initial Qualification Sample

The low viscosity sample shall have a viscosity value less than the high viscosity sample and greater than or equal to the viscosity of the sample submitted for endurance time testing (refer to ARP5485). The following tests shall be conducted on the low viscosity sample:

a. Viscosity shall be measured at 20 °C ± 2 °C (68 °F ± 4 °F) and 0 °C ± 2 °C (32 °F ± 4 °F), at 0.3 rpm, 6 rpm, and 30 rpm in accordance with 3.2.3.2.1.

b. WSET in accordance with 3.2.4.1.

c. Aerodynamic performance in accordance with AS5900. The test shall consist of one data point, three runs, using the neat fluid. The test shall repeat the lowest temperature ±1 °C (2 °F), at which the high viscosity sample met the aerodynamic performance requirements.

4.2.2.3 U.S. Military Procurement

For direct U.S. Military procurement, substantiating test data and, when requested, initial qualification fluid shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.2.3 Periodic Requalification Tests

Anti-icing acceptance (3.2.4), viscosity (3.2.3.1) and aerodynamic acceptance (3.2.5) are periodic requalification tests and shall be performed prior to the expiration of the previous anti-icing performance, viscosity and aerodynamic acceptance tests (approximately every 2 years).

Expiration dates of anti-icing performance (3.2.4) and aerodynamic acceptance (3.2.5) periodic requalification tests will be as follows:

- Tests performed between January 1st and May 31st: June 1st two calendar years after the performance of the test (e.g., test performed March 15, 2019 will expire on June 1, 2021).

- Tests performed between June 1st and December 31st: Two calendar years after the performance of the test (e.g., test performed August 15, 2019 will expire August 15, 2021).

These dates have been chosen (a) to facilitate timely publication of initial qualification test data, and (b) to avoid a backlog at the test lab. Manufacturers are encouraged to submit samples early in the year to assist the test lab and regulators meet these objectives.

A recent (not older than 6 months) production fluid sample shall be used for periodic requalification tests. When the fluid is intended for use diluted, the dilutions shall also be tested.

Aerodynamic acceptance (3.2.5) shall be performed by an approved and autonomous test facility. Anti-icing performance (3.2.4) shall be performed by an autonomous facility, unless another facility is agreed upon between the purchaser or user and the vendor.

4.3 Sampling and Testing

Shall be in accordance with 4.3.1 or 4.3.2, as applicable. A lot shall be all fluid produced in one continuous manufacturing process using materials from the same batches of raw materials and presented for vendor's inspection at one time. Sufficient fluid from a single production lot shall be taken to perform all required tests.

4.3.1 Bulk Shipments

In accordance with ASTM D4177.

4.3.2 Drum Shipments

In accordance with ASTM D1568.

4.3.3 When a statistical sampling plan has been agreed upon by the purchaser and the vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 or 4.3.2, and the report of 4.5 shall state that such a plan was used.

4.4 Approval

4.4.1 A sample fluid shall be approved by the purchaser before fluid for production use is supplied, unless such approval is waived by purchaser. Results of tests on production fluid shall be essentially equivalent to those on the approved sample.

4.4.2 The vendor shall use ingredients, manufacturing processes, and methods of inspection for production fluid which are essentially the same as those used to produce the fluid which is presented for qualification to this specification. If it is necessary to make any change in ingredient or the manufacturing process, the vendor shall submit such fluid for re-approval. Production fluid made by the revised procedure shall not be shipped to the purchaser until full testing and approval has been received.

4.4.3 Whenever a fluid is to be produced at multiple locations, or by a licensee or subcontractor, testing shall be required on fluid produced by each production unit, at each site, prior to initial shipment. Fluid produced by these production units shall be periodically tested according to 4.2.3.

4.4.3.1 If the production method, materials, and handling are not the same as the originally qualified vendor's production method, materials, and handling, all testing shall be required on fluid produced at each site, as if the fluid were being initially qualified (see 4.2.2).

4.4.3.2 If the production method, materials, and handling are the same as the originally qualified vendor's production method, materials, and handling, the fluid shall be confirmed by the aerodynamic acceptance test (3.2.5) and by a single test run of three panels under WSET (3.2.4.1) for the neat fluid.

4.5 Reports

4.5.1 Initial Qualification and Periodic Requalification Reports

4.5.1.1 Initial Qualification

Before the initial shipment, the vendor of fluid shall furnish a report showing the results of tests to determine conformance to all the technical requirements of this specification. These tests shall be performed by an approved and/or independent testing facility/facilities (see 4.2.2). The facility performing the aerodynamic acceptance test shall determine and report the following properties from the sample of fluid submitted for testing:

a. Viscosity (3.2.3.1)

b. Refractive index (3.2.1.4)

c. pH (3.2.1.3)

d. Surface tension (3.2.1.5)

4.5.1.2 Periodic Requalification

After periodic requalification testing, the vendor shall furnish a report showing the results of the periodic requalification anti-icing performance (3.2.4), aerodynamic acceptance (3.2.5) and viscosity (3.2.3.1) tests.

Subsequent reports of the results of periodic requalification tests shall be compared to the results obtained from the initial fluid qualification documents to confirm product consistency.

For the neat fluid, the WSET result (3.2.4.1) for the periodic requalification sample shall not be less than the WSET result for the lowest on-wing viscosity (LOWV as defined in ARP5718A, 3.3.1, sample selection) neat fluid sample used for endurance time testing.

The viscosity of the neat, 75/25 and 50/50 fluid requalification samples shall be between the high and low viscosities (4.2.2.1 and 4.2.2.2) of the respective neat, 75/25 and 50/50 samples used for initial qualification testing (see also 3.2.3.3). For comparison purposes, exactly the same viscosity measurement method shall be used for requalification testing as was used for the initial qualification testing.

The same requalification samples (neat, 75/25 and 50/50) shall show acceptable aerodynamic performance (3.2.5).

The variability in each test shall be taken into account.

4.5.1.3 Test Facilities

Both initial qualification and periodic requalification tests shall be performed by an approved and/or independent test facility (see 4.2.3).

4.5.1.4 Both the initial qualification and periodic requalification reports shall include the quantity, lot number, AMS1428 (latest revision) and manufacturer's product identification, date of manufacture, and manufacturing location.

4.5.2 Safety Data Sheets (SDS)

A safety data sheets (SDS) conforming to ANSI Z400.1/Z129.1-2010, or equivalent for the countries in which the product will be sold, shall be supplied to each purchaser prior to or concurrent with the report of preproduction test results or, if the preproduction test be waived by purchaser, concurrent with the first shipment of fluid for production use. Modification of the fluid formulation or change in the reportable status of any of the raw materials used shall be accompanied by a revised SDS.

4.6 Re-Sampling and Re-Testing

If any sample used in the above tests fails to meet the specified requirements, disposition of the fluid may be based on the results of testing three additional samples for each original non-conforming sample. Failure of any re-tested sample to meet the specified requirements shall be cause for rejection of the fluid represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY

5.1 Packaging and Identification

5.1.1 The fluid shall be packaged in containers of a size and type acceptable to purchaser or shall be delivered in bulk.

5.1.1.1 A production lot of fluid may be packaged in several or various containers and be delivered under the basic approval provided that lot identification is maintained.

5.1.2 Except for bulk delivery, each container shall be legibly marked with not less than the manufacturer's identification, lot number, quantity, AMS1428/1 Type II, III, or IV aircraft deicing/anti-icing fluid glycol based, or AMS1428/2 Type II, III, or IV aircraft deicing/anti-icing fluid non-glycol based and, if requested, purchase order number and date of manufacture.

5.1.3 Containers of fluid shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, labeling, and safe transportation of the fluid to ensure carrier acceptance and safe delivery.

5.1.4 For direct U.S. Military procurement, fluid shall be packaged, such that it is adequately protected from deterioration or physical damage during shipment from the source of supply to the procurement activity, or its designated receiving point, and (except for bulk delivery) for a minimum storage period of 30 days from the date of delivery (or a period defined by the purchaser) unless otherwise designated in the contract or purchase order (see also 9.2).

6. ACKNOWLEDGMENT

A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Fluid not conforming to this specification, or to modifications approved by purchaser, shall be subject to rejection.

8. SIMILAR SPECIFICATIONS

None.

9. NOTES

NOTICE

This document references a part which contains cadmium as a plating material. Consult local officials if you have questions concerning cadmium's use.

NOTICE

This specification may reference the use of substances, products, or processes that are restricted or banned by local (regional) chemical substance regulations. Users of this specification should consider the implications of local legislation on the products, substances, and processes referred to within the document.

9.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

9.2 Terms used in this AMS are clarified in ARP1917.

9.3 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

9.4 Purchase documents should specify not less than the following:

AMS1428L
AMS1428/1 or AMS1428/2
Type of fluid required, or limitations (if applicable)
Size and type of containers desired
Quantity of fluid desired
Packaging requirements (see 5.1.3)

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