INTERNATIONAL STANDARD

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Aerospace — Aircraft de-icing/anti-icing Newtonian fluids, ISO type I

Aéronautique et espace — Liquides newtoniens ISO type I de dégivrage/antigivrage des aéronefs

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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11075 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Sub-Committee SC 9, *Air cargo and ground equipment*.

Annex A of this International Standard is for information only.

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Aerospace — Aircraft de-icing/anti-icing Newtonian fluids, ISO type I

1 Scope

This International Standard establishes the requirements for Newtonian fluids used in the removal and prevention of ice, snow or frost on exterior surfaces of parked aircraft.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1518:1992, *Paints and varnishes — Scratch test.*

ISO 2719:1988, *Petroleum products and lubricants — Determination of flash point — Pensky-Martens closed cup method.*

ISO 3013:1974, *Aviation fuels — Determination of freezing point.*

ISO 3104:—[1], *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity.*

ISO 3675:1993, *Crude petroleum and liquid petroleum products — Laboratory determination of density or relative density — Hydrometer method.*

ISO 11078:1993[2], *Aerospace — Aircraft de-icing/anti-icing non-Newtonian fluids, ISO type II.*

OECD guidelines for testing of chemicals. Section 3 — Degradation and Accumulation. Ready Biodegradability. 301 D Closed Bottle Test.[3]

AMS 2470H, *Anodic Treatment, Aluminium Alloys, Chromic Acid Process.*[4]

AMS 2475D, *Protective Treatment, Magnesium Base Alloys.*

AMS 4037L, *Aluminium Alloy Sheet and Plate, 4.4Cu — 1.5Mg — 0.60Mn (2024-T3 Flat Sheet, -T351 Plate), Solution Heat Treated, UNS A92024.*

AMS 4041M, *Aluminium Alloy Sheet and Plate, Alclad, 4.4Cu — 1.5Mg — 0.6Mn, (Alclad 2024 and 1 — 1/2 % Alclad 2024,-T3 Flat Sheet; 1 — 1/2 % Alclad 2024-T351 Plate).*

AMS 4049H, *Aluminium Alloy Sheet and Plate, Alclad, 5.6Zn — 2.5Mg — 1.6Cu — 0.23Cr (Alclad 7075-T6 Sheet,-T651 Plate), Solution and Precipitation Heat Treated.*

AMS 4376E, *Magnesium Alloy Plate, 3.0Al — 1.0Zn (AZ31B-H26), Cold Rolled and Partially Annealed.*

AMS 4911F, *Titanium Alloy Sheet, Strip, and Plate, 6Al — 4V, Annealed.*

AMS 6350H, *Steel Sheet, Strip and Plate, 0.95Cr — 0.20Mo (0.28-0.33C).*

1) To be published. (Revision of ISO 3104:1976)

2) To be published.

3) This publication is available from the OECD, 2, rue André-Pascal, 75 775 Paris cedex 16, France.

4) AMS standards are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, USA.

ASTM A 109M-90a, *Specification for Steel, Carbon, Cold-Rolled Strip [Metric]*.[5]

ASTM D 1193-77, *Specification for Reagent Water.*

ASTM D 1331-89, *Test Methods for Surface and Interfacial Tension of Solutions of Surface-Active Agents.*

ASTM D 1747-89, *Test Method for Refractive Index of Viscous Materials.*

ASTM E 70-90, *Test Method for pH of Aqueous Solutions with the Glass Electrode.*

ASTM F 483-90, *Method for Total Immersion Corrosion Test for Aircraft Maintenance Chemicals.*

ASTM F 484-83, *Test Method for Stress Crazing of Acrylic Plastics in Contact with Liquid or Semi-Liquid Compounds.*

ASTM F 485-90, *Test Method for Effects of Cleaners on Unpainted Aircraft Surfaces.*

ASTM F 502-83, *Test Method for Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces.*

ASTM F 519-77, *Method for Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals.*

ASTM F 945-85, *Test Method for Stress-Corrosion of Titanium Alloys by Aircraft Engine Cleaning Materials.*

ASTM F 1104-87, *Test Method for Preparing Aircraft Cleaning Compounds, Liquid Type, Water Base, for Storage Stability Testing.*

ASTM F 1110-90, *Test Method for Sandwich Corrosion Test.*

ASTM F 1111-88, *Test Method for Corrosion of Low Embrittling Cadmium Plate by Aircraft Maintenance Chemicals.*

BAC 5718, *Low Hydrogen Embrittlement Cadmium Plating.*[6]

MIL-P-83310, *Plastic sheet, polycarbonate, transparent.*[7]

DIN 65 321:1989, *Aerospace; Acrylic sheets, panes and moulded parts; Technical specification.*[8]

WL 5.1416:1992, *Aerospace; acrylic material, cast, crosslinked, in 5.1415 material, biaxially stretched and crack propagation resistant.*[8]

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 Newtonian fluid: Fluid whose viscosity is shear independent and time independent. The shear rate of a Newtonian fluid is directly proportional to the shear stress. A Newtonian fluid will begin to move immediately upon application of a stress; it has no yield stress which must be achieved before flow begins.

3.2 lot: All compound produced in a single production run from the same batches of raw materials under the same fixed conditions and presented for vendor's inspection at one time.

NOTE 1 The compound may be packaged in smaller quantities under the basic lot approval provided lot identification is maintained.

3.3 preproduction test: Test to determine conformance to all technical requirements of this International Standard.

3.4 acceptance test: Test performed to determine conformance to the requirements given in 4.2.6, 4.2.7 and 4.2.10.

3.5 periodic test: Test to determine conformance to the requirements given in 4.2.8.2 and 4.5.

4 Performance requirements

4.1 Composition

The fluid shall contain a freezing-point depressant. The composition of the fluid shall otherwise be at the manufacturer's discretion. The fluid may contain additives, provided the requirements of this International Standard are met.

When glycols are used as the freezing-point depressant, the fluid shall include an inhibitor to minimize the potential fire hazard resulting from the interaction between aqueous glycol solutions and noble

5) ASTM standards are available from American Society of Testing and Materials, 1916 Race Street, Philadelphia, PA 19103, USA.

6) Available from Boeing Company.

7) US Government Publications are available from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabot Avenue, Philadelphia, PA 19120, USA.

8) Available from DIN (Deutsches Institut für Normung, e.V.), Postfach, D-10772 Berlin, Germany.

metal electrodes impressed with a direct current potential.

Slippery conditions can be present following the deicing procedure. Caution should be exercised, particularly under low humidity or non-precipitating weather conditions. The fluid shall meet local requirements for pavement compatibility.

NOTE 2 Pavement compatibility requirements will be specified after the US Federal Aviation Agency (FAA) has established a standardized test method.

4.2 Properties

The fluid shall have the following properties.

4.2.1 Flash point

The flash point shall not be lower than 100 °C (212 °F), determined in accordance with ISO 2719.

4.2.2 Specific gravity

The specific gravity shall be within ± 1,5 % of the nominal value, determined in accordance with ISO 3675.

4.2.3 Storage stability

The fluid as delivered shall offer enough stability to guarantee 2 years storage in an airport environment. Compliance with this requirement shall be demonstrated by testing the fluid in accordance with ASTM F 1104. The fluid shall show neither separation from exposure to heat or cold nor an increase in turbidity greater than a freshly-made control sample diluted 1 + 1 with ASTM D 1193 Type IV water. The hot test shall be conducted at 80 °C ± 2 °C (176 °F ± 3,6 °F) for a duration of 30 d. The cold test shall be conducted for a duration of 30 d.

4.2.4 Hard water compatibility

The fluid diluted 1 + 1 with standard hard water (as specified in 4.2.4.1) when submitted to the stability test specified in 4.2.4.2, shall not show any insoluble deposit or increase in turbidity greater than the freshly made control sample diluted 1 + 1 with ASTM D 1193 Type IV water. The pH of the tested sample shall be within ± 0,5 of the initial value.

4.2.4.1 Composition of standard hard water

Dissolve 400 mg ± 5 mg of calcium acetate [$(CH_3COO)_2Ca \cdot 2H_2O$] and 280 mg ± 5 mg of magnesium sulfate ($MgSO_4 \cdot 7H_2O$) in 1 l of ASTM D 1193 Type IV water.

4.2.4.2 Stability test of diluted solution

Heat 350 ml of the diluted fluid at 95 °C ± 2 °C (203 °F ± 3,6 °F) in a 500 ml glass jar fitted with a sealed cap or a water condenser for 30 d.

At the end of this period, perform a visual inspection and pH measurement and compare the results with those of the fresh sample.

4.2.5 Colour

The fluid may be either dyed or undyed, at the purchaser's request. A dyed fluid shall be coloured red-orange, with a strength not exceeding that of a sample of fluid containing 100 ppm of dye having a CI Solvent Orange 59 (Colour Index) or equivalent.

4.2.6 pH

The pH of the fluid as determined in accordance with ASTM E 70 shall be within ± 0,5 of the nominal value taken from the sample submitted for certification testing.

4.2.7 Freezing point

The freezing point of the fluid shall be within 3 °C (5,4 °F) of the nominal value, determined in accordance with ISO 3013. For the neat fluid, a sample diluted 1 + 1 with ASTM D 1193 Type IV water shall have a freezing point not greater than − 20 °C (− 4 °F).

4.2.8 Rheology

The fluid shall exhibit Newtonian flow behaviour over the temperature range of − 30 °C to + 80 °C (− 22 °F to 176 °F).

4.2.8.1 Viscosity

The viscosity of the fluid shall be within ± 10 % of the preproduction values at − 30 °C (− 22 °F) and + 20 °C (68 °F), determined in accordance with ISO 3104.

4.2.8.2 Aerodynamic performance

The fluid shall demonstrate acceptable aerodynamic performance in accordance with annex B of ISO 11078.

4.2.9 Surface tension

When measured in accordance with ASTM D 1331, the surface tension of the fluid as delivered shall not be greater than 40×10^{-3} N/m (40 dyn/cm) at 20 °C (68 °F).

4.2.10 Refractive index

The refractive index of the fluid, as determined in accordance with ASTM D 1747, shall be within 0,001 5 units of the nominal value at 20 °C (68 °F).

4.3 Materials compatibility

The materials compatibility tests given in the following subclauses shall be performed on the following samples:

a) concentrated fluid;

b) fluid diluted 1 + 1 with ASTM D 1193 Type IV water.

4.3.1 Corrosion of metal surfaces

4.3.1.1 Sandwich corrosion

Specimens, after test, shall not show a sandwich corrosion rating worse than 1 or worse than reagent water, when tested in accordance with ASTM F 1110.

4.3.1.2 Total immersion corrosion

The fluid shall neither show evidence of corrosion nor cause a change in mass per unit area of any test panel greater than that given in table 1, when tested in accordance with ASTM F 483.

Table 1 — Maximum permitted daily change in mass per unit area

Test panel	Relevant standard	Maximum permitted daily change mg/cm²
Aluminium alloy, anodized in accordance with AMS 2470	AMS 4037	0,3
Aluminium alloy	AMS 4041	0,3
Aluminium alloy	AMS 4049	0,3
Magnesium alloy, dichromate treated in accordance with AMS 2475	AMS 4376	0,2
Titanium alloy	AMS 4911	0,1
Carbon steel, temper 5	ASTM A 109	0,8
Steel, cadmium plated, in accordance with BAC 5718	AMS 6350	0,3

4.3.1.3 Low-embrittling cadmium plate

Test panels coated with low-embrittling cadmium plate shall not show a daily change in mass per unit area greater than 0,3 mg/cm² in accordance with ASTM F 1111.

4.3.1.4 Stress corrosion resistance

The fluid shall not cause cracks in titanium specimens when tested in accordance with heat method A of ASTM F 945.

4.3.1.5 Hydrogen embrittlement

The fluid shall be non-embrittling, when tested in accordance with ASTM F 519 using a test specimen of either type 1a, 1c or 2a.

4.3.2 Effect on plastic

4.3.2.1 Effect on acrylic material

The fluid, when heated to 65 °C ± 2 °C (149 °F ± 3,6 °F), shall not craze, stain or discolour DIN 65 321, stretched WL 5.1416 acrylic material when tested in accordance with ASTM F 484.

4.3.2.2 Effect on polycarbons

The fluid shall not craze, stain or discolour MIL-P-83310 polycarbonate plastic when tested using the general procedure specified in ASTM 484 except that the specimen shall be stressed for 30 min ± 2 min to an outer fibre stress level of 13,793 MPa (2 000 psi).

4.3.3 Effect on painted surfaces

4.3.3.1 A painted surface, to which the fluid has been applied for 7 d at 22 °C (71,6 °F), shall withstand a load of 1 200 g when tested in accordance with ISO 1518.

4.3.3.2 The fluid, heated to 65 °C ± 2 °C (149 °F ± 3,6 °F) and applied to a painted surface having an initial surface temperature of 22 °C (71,6 °F), shall not produce any streaking, discolouration or blistering of the paint film tested in accordance with ASTM F 502.

4.3.4 Effect on unpainted surfaces

The fluid, tested in accordance with ASTM F 485, shall neither produce streaking nor leave any stain requiring polishing to remove.

4.4 Environmental protection

4.4.1 Biodegradability

The fluid shall meet local requirements for biodegradability and shall not have an overall biodegradability of less than 90 %. Results of biodegradability studies conducted in accordance with the OECD Ready Biodegradability Closed Bottle Test 301 D, shall be provided by the fluid manufacturer to

the purchaser and shall contain not less than the following information:

a) a statement of the ecological behaviour of the fluid;

b) the total oxygen demand (TOD) of the fluid, expressed in pounds of oxygen per pound of fluid;

c) percentage of fluid degraded in 5 days [5 day biological oxygen demand (BOD)];

d) concentration, expressed as a percentage by mass, of sulfur, halogens, phosphate, nitrate and heavy metals (lead, chromium, cadmium and mercury).

4.4.2 Aquatic toxicity

The aquatic toxicity shall meet the local requirements.

4.4.3 Toxicity

The toxicity shall meet the local requirements.

4.5 Anti-icing performance

ISO type I fluids (diluted 1 + 1 with standard hard water as specified in 4.2.4.1) shall protect against formation of frozen deposits for a minimum of 20 min in the high humidity endurance test and for a minimum of 3 min in the water spray endurance test as described in annex A of ISO 11078.

5 Quality assurance provisions

5.1 Responsibility for inspection

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 5.5.

The purchaser reserves the right to sample and to perform any confirmation testing deemed necessary to ensure that the product conforms to the requirements of this International Standard.

5.2 Frequency of testing

5.2.1 Preproduction tests

Preproduction tests shall be performed:

a) prior to initial shipment of the product to a purchaser;

b) when a change in material, processing or both requires reapproval as in 5.4.2;

c) when the purchaser deems confirmation testing to be necessary.

5.2.2 Periodic tests

Periodic tests shall be performed biannually.

5.2.3 Acceptance tests

Acceptance tests shall be performed on each lot.

5.3 Sampling

5.3.1 Preproduction and periodic tests

Sufficient product from a single production lot shall be taken at random to perform all required tests.

5.3.2 Acceptance tests

Sufficient product shall be taken at random from each lot to perform all required tests.

5.4 Approval

5.4.1 The preproduction compound shall be approved by the purchaser before fluid for production use is supplied. Result of tests on production fluid shall be essentially equivalent to those on the approved sample fluid.

5.4.2 The vendor shall use ingredients, manufacturing procedures and methods of inspection on the production fluid which are essentially the same as those used on the approved preproduction sample. If necessary to make changes in ingredients, formulation or manufacturing procedures, the vendor shall submit for reapproval a statement of proposed changes. The results of retesting for anti-icing and aerodynamic performance as specified in 4.5 and 4.2.8.2 respectively as well as those for any other test deemed necessary by the purchaser shall also be submitted.

5.5 Test reports

5.5.1 Preproduction and periodic test reports

The vendor of the fluid shall furnish, before the initial shipment, a report showing the results of preproduction tests.

In addition, the accepted and preferably independent testing facility or facilities carrying out the periodic tests shall determine the fluid specimen properties listed in table 2. These results shall be compared to those given in the manufacturer's documentation of their anti-icing and aerodynamic performance tests and shall be reported.