



AEROSPACE MATERIAL SPECIFICATION

AMS1431™**REV. F**Issued 1992-01
Revised 2024-03

Superseding AMS1431E

(R) Solid Runway Deicing/Anti-icing Product

RATIONALE

This specification has been revised to include clarification on qualification requirements, remove 3.2.9.5.1 related to the stress corrosion resistance of AMS4911 titanium alloy specimens and 8.2 related to the use of terms in ARP1917, and to clarify reporting requirements.

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1. SCOPE

1.1 Form

This specification covers a runway deicing and anti-icing product in the form of a solid. Unless otherwise stated, all specifications referenced herein are latest (current) revision.

1.2 Application

These products have been used typically at airports on aircraft maneuvering areas, such as aprons, runways, and taxiways, for the prevention and removal of frozen deposits of snow, frost, and ice, but usage is not limited to such applications.

1.3 Precautions

1.3.1 Material Compatibilities

While this specification covers technical requirements for solid runway deicing/anti-icing products, it does not address the compatibility issue of combining runway deicing products during the operational phase. Products meeting this specification are unique to each manufacturer and may be adversely affected by combining with other deicing/anti-icing products. It is the user's responsibility to become familiar with the safe and proper use of applying multiple deicing/anti-icing products.

1.3.1.1 Dissolved/Brined Solid Deicing Product

When the solid deicing/anti-icing product is dissolved in water in a process called dissolution or brining and used as a liquid runway deicing/anti-icing product, the resulting solution (the brine) at the highest recommended dilution shall meet the requirements of AMS1435.

1.3.2 Pavement Friction Evaluation

Airport authorities should ascertain the friction coefficient of the runway after the application of a deicing/anti-icing product prior to aircraft landing operations.

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1.3.3 Airfield Requirements

Some airfields, including USAF-controlled airfields, may have additional requirements not included in this specification that the product must meet for use on the airfield. Consult the governing agency of the airfield to ensure all requirements are met.

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 that 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 to take necessary precautionary measures to ensure the health and safety of all personnel involved.

1.5 Fluid Qualification

1.5.1 Previous Qualification

For products qualified under previous versions of this specification, only tests for which the technical requirements have changed in subsequent versions from the original qualification need to be performed in order for the product to meet the requirements of the current version of this specification.

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.

AMS1435	Liquid Runway Deicing/Anti-Icing Product
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
AMS-P-83310	Plastic Sheet, Polycarbonate, Transparent

AIR5567	Test Method for Catalytic Carbon Brake Disk Oxidation
AIR6130	Cadmium Plate Cyclic Corrosion Test
AS6170	Ice Melting Test Method for AMS1431 and AMS1435 Runway Deicing/Anti-Icing Products
AS6172	Ice Undercutting Test Method for AMS1431 and AMS1435 Runway Deicing/Anti-Icing Products
AS6211	Ice Penetration Test Method for AMS1431 and AMS1435 Runway Deicing/Anti-icing Products

2.2 ANSI Accredited Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ANSI Z400.1/Z129.1-2010 Hazardous Workplace Chemicals - Hazard Evaluation and Safety Data Sheet and Precautionary Labeling Preparation

2.3 APHA Publications

Available from American Public Health Association, 800 I Street, NW, Washington, DC 2001-3710, Tel: 888-320-2742, www.apha.org.

Standard Methods for the Examination of Water and Waste Water, Method 4500-Cl

2.4 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 Deicing Chemicals
ASTM D56	Standard Test Method for Flash Point by Tag Closed Tester
ASTM D1193	Reagent Water
ASTM D1568	Sampling and Chemical Analysis of Alkylbenzene Sulfonates
ASTM E70	pH of Aqueous Solutions with the Glass Electrode
ASTM E203	Water Using Karl Fischer Reagent
ASTM F483	Total Immersion Corrosion Test for Aircraft Maintenance Chemicals
ASTM F484	Stress Cracking 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 Testing of Plating Processes and Aircraft Maintenance Chemicals
ASTM F945	Stress Corrosion of Titanium Alloys by Aircraft Engine Cleaning Materials
ASTM F1104	Preparing Aircraft Cleaning Compounds, Liquid Type, Water Base, for Storage Stability Testing
ASTM F1110	Sandwich Corrosion Test
ASTM F1111	Corrosion of Low-Embrittling Cadmium Plate by Aircraft Maintenance Chemicals

2.5 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 5725 Accuracy (trueness and precision) of measurement methods and results

2.6 LFV Test Method 2-98 Publications

Available from Swedish Civil Aviation Administration, LFV Teknik, Box 53, SE-190 45 Stockholm-Arlanda, Sweden.

2.7 Organisation for Economic Co-operation and Development Publications

Available from Organisation for Economic Co-operation and Development, 2 Rue Andre Pascal, 75775 Paris Cedex 16, France, Tel: +33 1 45 24 82 00, www.oecd.org.

OECD Guidelines for Testing of Chemicals, Methods 202 and 203

2.8 U.S Government Publications

Available from U.S. Government Printing Office, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-932, www.epa.gov.

EPA 40CFR 797.1300 Daphnid Acute Toxicity Test

EPA 40CFR 797.1400 Fish Acute Toxicity Test

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

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

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

MIL-STD-2073-1 DoD Material Procedures for Development and Packaging Requirements

3. TECHNICAL REQUIREMENTS

3.1 Material

The composition of the product may contain additives, such as corrosion inhibitors, coating agents, etc., as required to produce a product meeting the requirements of this specification.

3.1.1 Environmental Information

The product shall be tested in accordance with APHA Standard Methods for Examination of Water and Waste Water. The manufacturer shall provide not less than the following information:

- 3.1.1.1 Biochemical oxygen demand (BOD) of the product for 5-, 15-, and 20-day incubation periods. The test solutions shall be incubated at 68 °F (20 °C).
- 3.1.1.2 Total oxygen demand (TOD) or chemical oxygen demand (COD) of the product, expressed in kilograms of oxygen per kilograms of product.
- 3.1.1.3 Percent biodegradation of product for 5-, 15-, and 20-day incubation periods. Percent biodegradation can be approximated by dividing BOD x 100 by either TOD or COD.

3.1.1.4 Aquatic Toxicity

The product shall be tested in accordance with EPA (40 Code of Federal Regulations [CFR] Parts 797.1300 and 797.1400) or OECD (Guidelines for Testing of Chemicals, Methods 202 and 203) procedures 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 test species survive, shall be given in milligrams per liter.

3.1.2 Trace Contaminants

Report the presence, in percentage by weight, of sulfur, halogens, phosphate, nitrate, and heavy metals (lead, chromium, cadmium, and mercury).

3.1.3 The vendor shall report the product chemical analysis, determined in accordance with a recognized method acceptable to the purchaser; and total water content shall be determined in accordance with ASTM E203.

3.1.4 The vendor shall provide a phase diagram relating product dilution to freezing point. Delivered product shall be within +7 °F (+4 °C) of the preproduction value.

3.1.5 Appearance

The product, as received by the purchaser, shall be uniform, free-flowing, and free from foreign material detrimental to usage of the product. If the product is colored, it shall be blue.

3.2 Physical Properties

The product, as supplied by the vendor, shall conform to the following requirements; tests shall be performed in accordance with specified test on the product as delivered by the vendor, unless otherwise specified herein:

3.2.1 pH

The product, diluted with ASTM D1193, Type IV water to 15% by weight of solids taking into account water contained in the product, shall be within ± 0.5 of the preproduction value established in 4.2.3, determined in accordance with ASTM E70.

3.2.2 Flash Point

The product on a dry basis shall be not lower than 200 °F (93 °C), determined in accordance with ASTM D56.

3.2.3 Chloride Content

The level of soluble chloride on a dry basis shall not exceed 250 ppm, determined in accordance with APHA Standard Methods for the Examination of Water and Waste Water, Method 4500-Cl or equivalent.

3.2.4 Storage Stability

The product, when stored in a closed container for at least 1 year in accordance with ASTM F1104, shall not deliquesce or otherwise deteriorate.

3.2.5 Effect on Transparent Plastics

3.2.5.1 The product, diluted with ASTM D1193, Type IV water to 15% by weight of solids taking into account water contained in the product, shall not craze, stain, or discolor Type C stretched acrylic plastic conforming to MIL-PRF-25690, determined in accordance with ASTM F484.

3.2.5.2 The product, diluted with ASTM D1193, Type IV water to 15% by weight of solids taking into account water contained in the product, shall not craze, stain, or discolor AMS-P-83310 polycarbonate plastic, determined in accordance with ASTM F484, except that the specimens shall be stressed for 30 minutes $\pm$ 2 minutes to an outer fiber stress of 2000 psi (13.8 MPa).

3.2.6 Effect on Painted Surfaces

The product, diluted with ASTM D1193, Type IV water to 15% by weight of solids taking into account water contained in the product, shall neither decrease the paint film hardness by more than two pencil hardness levels nor shall it produce any streaking, discoloration, or blistering of the paint film, determined in accordance with ASTM F502.

3.2.7 Effect on Unpainted Surfaces

The product, diluted with ASTM D1193, Type IV water to 15% by weight of solids taking into account water contained in the product, shall neither produce streaking nor leave stains that require polishing to remove, determined in accordance with ASTM F485.

3.2.8 Effect on Runway Pavements

3.2.8.1 Runway Concrete Surface 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 concrete shall:

- a. Be air-entrained with an air content as specified in ASTM C672.
- b. Have a minimum cement content of $510 \text{ lb/yd}^3 \pm 10 \text{ lb/yd}^3$ ($302 \text{ kg/m}^3 \pm 6 \text{ kg/m}^3$).
- c. Have a slump of $1.5 \text{ inches} \pm 0.5 \text{ inch}$ ($38 \text{ mm} \pm 13 \text{ mm}$).

A 25% by volume solution of the deicing/anti-icing product as supplied by the manufacturer in commercial concentration in tap water shall be substituted for calcium chloride. Performing more than one freeze-thaw cycle per day is acceptable.

3.2.8.2 Asphalt Concrete Degradation Resistance (Appendix A, Valid for Runway Deicing/Anti-Icing Products used in Europe)

The product, diluted with tap water to 50% or regular highest concentration by weight of solid, shall be tested in accordance with LFV Method 2-98 (see Appendix A). The reduction in adhesion value of the runway asphalt concrete surface shall not be more than 50% of the adhesion value of the specimens not stored in deicing diluted product. Adhesion values shall be determined and documented. The following test parameters shall be used:

- a. Marshall test specimens with paving grade bitumen 160/220 (penetration value at 77°F [25°C] of $180 \text{ mm}^{-1} \pm 10 \text{ mm}^{-1}$ and softening point $102^\circ\text{F} \pm 1^\circ\text{F}$ [$39^\circ\text{C} \pm 1^\circ\text{C}$]) shall be used.
- b. Binder content 5.7% by mass.
- c. Maximum aggregate size 0.625 inch (16 mm) and distribution as shown in Figure 1.

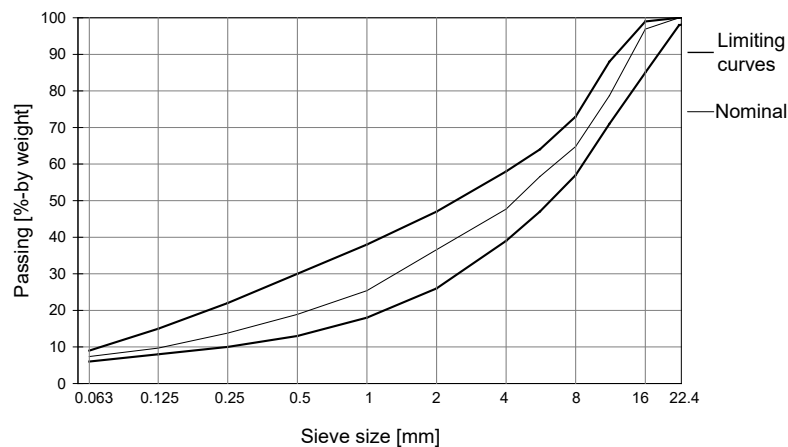


Figure 1 - Aggregate size distribution

- d. The aggregate used shall be characterized regarding variety of stone, origin, and petrographical analysis. The aggregate shall be of good mechanical stability.
- e. Air voids $7\% \pm 1\%$ by volume.
- f. Specimens are sawed to approximately 1.125-inch (30-mm) thickness.

3.2.9 Effect on Aircraft Metals

The product, diluted with ASTM D1193, Type IV water to 5% and 15% by weight solids taking into account water contained in the product, shall meet the following requirements:

3.2.9.1 Sandwich Corrosion

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

3.2.9.2 Total Immersion Corrosion

The product, tested in accordance with ASTM F483, except that panels shall be AMS4376 tested for 24 hours, shall neither cause corrosion of test panels nor a weight change of any test panel greater than shown in Table 1.

Table 1 - 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 Titanium Alloy	0.1
AMS5045 Carbon Steel	0.8

3.2.9.3 Low-Embrittling Cadmium Plate

Test panels, coated with low-embrittling cadmium plate, shall not show a weight change greater than 0.3 mg/cm² per 24 hours, determined in accordance with ASTM F1111.

3.2.9.3.1 The product shall be tested for cyclic immersion corrosion of cadmium plate in accordance with AIR6130 and the results reported as specified in Section 6 of AIR6130.

3.2.9.4 Hydrogen Embrittlement

The diluted product 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. Type 1a and Type 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 specimens shall be immersed continuously in the solution under test for 150 hours at a temperature of 77 °F ± 9 °F (25 °C ± 5 °C).

3.2.9.5 Stress Corrosion Resistance

The diluted product shall not cause cracks in AMS4911 titanium alloy specimens, determined in accordance with ASTM F945, Method A.

3.2.9.5.1 Repealed

3.2.10 Performance

The product, used in accordance with the manufacturer's recommendation, shall remove accumulated frozen deposits of frost and ice from aircraft maneuvering areas, such as airport aprons, runways, and taxiways. The product shall be tested in accordance with AS6170 for ice melting effectiveness, with AS6172 for ice undercutting effectiveness, and with AS6211 for ice penetration effectiveness. Acceptance criteria shall be agreed upon by the purchaser and vendor.

3.2.11 Effect on Carbon-Brake Systems

The product shall be tested for catalytic oxidation of carbon in accordance with AIR5567, and the results shall be reported as shown in 4.2 of AIR5567. The results shall be reported for informational purposes only. Per AIR5567, the lower the percentage weight loss, the lower the risk of the carbon-carbon heat sink being damaged through catalytic oxidation.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of the product shall supply all samples for conformance testing and shall be responsible for obtaining independent laboratory confirmation of conformance to the requirements of this specification. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Total water content (see 3.1.3), pH (see 3.2.1), flash point (see 3.2.2), and chloride content (see 3.2.3) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests

Effect on transparent plastics (see 3.2.5), effect on painted surfaces (see 3.2.6), effect on unpainted surfaces (see 3.2.7), runway concrete scaling resistance (see 3.2.8.1), asphalt concrete degradation resistance (see 3.2.8.2 and Appendix A; valid for runway deicing/anti-icing products used in Europe), and effect on aircraft metals (see 3.2.9) are periodic tests and shall be performed on or just prior to the second anniversary of initial testing and thereafter every 4 calendar years.

4.2.3 Preproduction Tests

All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of the product to a purchaser, when a change in ingredients and/or manufacturing procedures requires reapproval as in 4.4.2, and when a purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing

Shall be in accordance with applicable requirements of ASTM D1568; a lot shall be all product produced in one continuous manufacturing operation from the same batches of raw materials and presented for the vendor's inspection at one time.

4.3.1 When a statistical sampling plan has been agreed upon by the purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3 and the report of 4.5 shall state that such plan was used.

4.4 Approval

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

4.4.2 The vendor shall use ingredients, manufacturing procedures, and methods of inspection on production product that are essentially the same as those used on the approved sample product. If necessary to make any change in ingredients or in manufacturing procedures, the vendor shall submit for reapproval a statement of the proposed changes in ingredients and/or manufacturing procedures and, when requested, sample product. The production product made by the revised procedure shall not be shipped prior to receipt of approval.

4.4.3 Whenever a product is to be produced by a licensee or subcontractor, all testing shall be required on a product produced at the site, prior to initial shipment as if the product were being initially qualified.

4.5 Reports

Before the initial shipment, the vendor of product shall furnish a report showing the results of tests to determine conformance to all technical requirements. These tests shall be carried out by an independent facility. This report shall include the manufacturer's product identification, lot number, AMS1431 (latest version), and manufacturing location.

4.5.1 A safety data sheet conforming to ANSI Z400, or equivalent, shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or, if preproduction testing be waived by the purchaser, concurrent with the first shipment of product for production use. Each request for modification of product formulation shall be accompanied by a revised safety data sheet.

4.6 Resampling and Retesting

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

5. PREPARATION FOR DELIVERY

5.1 Packaging and Identification

- 5.1.1 The product shall be packaged in clean containers of a type and size acceptable to the purchaser and vendor.
- 5.1.2 Each container of product shall be legibly marked with not less than AMS1431F, the phrase "FOR AIRFIELD USE," the manufacturer's product identification, purchase order number, lot number, and quantity.
- 5.1.3 Labeling requirements shall meet all federal, state, and local laws. In the United States, there are states whose right-to-know regulations relate to labeling. Product manufactured, stored, or used in those states is subject to those regulations.
- 5.1.4 Containers of product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT

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

7. REJECTIONS

Product not conforming to this specification, or to modifications authorized by the purchaser, will be subject to rejection.

8. NOTES

8.1 Revision Indicator

A change bar (I) 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.

8.2 Repealed

- 8.3 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.

8.4 Purchase documents should contain the following:

AMS1431F

Type of solid required or limitations (if applicable)

Size and type of containers desired (see 5.1.4)

Quantity desired

- 8.5 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.