AEROSPACE MATERIAL SPECIFICATION

AMS1435™	REV. E
Issued 1995-04 Revised 2024-03 Superseding AMS1435D	

Liquid Runway Deicing/Anti-icing Product

RATIONALE

This specification has been revised to include clarification on qualification requirements, remove 1.3.3 related to the electrochemical dehydrolyis of glycols, 3.2.5.5.1 related to the stress corrosion resistance of AMS4916 titanium alloy specimens, and 8.3 related to the use of terms in ARP1917, and to clarify reporting requirements.

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS1435E/

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1. SCOPE

1.1 Form

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

1.2 Application

These products have been used typically at airports on runways, taxiways, and other aircraft maneuvering areas for the prevention and removal of frozen deposits of snow, frost, and ice, but usage is not limited to such applications. These products must not be used to deice/anti-ice aircraft.

1.3 Precautions

1.3.1 Product Compatibilities

While this specification covers technical requirements for liquid 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 could be adversely affected by mixing 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 Diluting a Liquid Runway Deicing Product

If the liquid deicing/anti-icing product is diluted and subsequently used as a liquid deicing/anti-icing product on runways, taxiways, and other aircraft maneuvering areas, the resulting liquid shall meet the latest revision requirements of AMS1435.

1.3.2 Pavement Friction Evaluation

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

1.3.3 Repealed

1.3.4 Airport authorities are advised that runway deicing products can cause failure of runway and taxiway lighting circuits. Damage potential depends on the condition of these systems, quantity of product usage, or the opportunity of product entry into electrical conduit systems. A comprehensive evaluation of the aeronautical lighting systems should be completed as part of winter operations planning.

1.3.5 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.

1.4.1 Some deicing/anti-icing products may be mildly toxic and contact with human skin and eyes should be avoided. Prolonged exposure to concentrations of vapor and wind-borne mists should be avoided. Prolonged exposure to concentrations exceeding any established threshold limit values (TLV) for those products or its major components should be avoided.

1.5 Fluid Qualification

1.5.1 Previous Qualifications

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.

AMS1431 Solid Runway Deicing/Anti-Icing Product

AMS2470 Anodic Treatment of Aluminum Alloys, Chromic Acid Process

AMS2475 Protective Treatments, Magnesium Alloys

AMS2825 Material Safety Data Sheets

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 20001-3710, Tel: 202-777-APHA, www.apha.org.

APHA Method 4500-CL Standard Methods for the Examination of Water and Wastewater

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 Flash Point by Tag Closed Cup Tester

ASTM D93 Flash Point by Pensky-Martens Closed Cup Tester

ASTM D891 SpecificGravity, Apparent, of Liquid Industrial Chemicals

ASTM D1177 Freezing Point of Aqueous Engine Coolants

ASTM D1193 Reagent Water

ASTM D1568 Sampling and Chemical Analysis of Alkylbenzene Sulfonates

ASTM D4057 Manual Sampling of Petroleum and Petroleum Products

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/Coating Processes and Service Environments

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

ASTM F1104 Preparing Aircraft Cleaning Compounds, Liquid Type, Water Based, for Storage Stability Testing

ASTM F1110 Sandwich Corrosion Test

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

2.5 EPA Publications

EPA 40 CFRs may be available at https://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR.

EPA Methods, US Title 40 Code of Federal Regulations (CFR)

EPA 40 CFR 797.1300 Daphnid Acute Toxicity Test

EPA 40 CFR 797.1400 Fish Acute Toxicity Test

2.6 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

2.7 LFV Test Method 2-98 Publications

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

2.8 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

2.9 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-290 Packaging and Marking of Petroleum and Related Products

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

3. TECHNICAL REQUIREMENTS

3.1 Material

The composition of the runway deicing product shall be optional with the manufacturer. The product may contain additives, such as corrosion inhibitors, urea, formamide, etc., as required to produce a product meeting the requirements of this specification.

3.1.1 Environmental Information

The manufacturer of the runway deicing product shall provide not less than the following information:

3.1.1.1 Biodegradability

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

3.1.1.1.1 The percent of product biodegraded in 5 days at 68 °F (20 °C).

3.1.1.1.2 The 5-day total oxygen demand (TOD) of the product based on theoretical oxygen demand (ThOD), whether calculated computationally or via measured chemical oxygen demand (COD), expressed in kilograms of oxygen per kilograms of product.

3.1.1.2 Ecological Behavior

A statement of the ecological behavior of the product shall include aquatic toxicity for the total formulation. The aquatic toxicity data shall be determined in accordance with EPA 40 CFR 797.1300, EPA 40 CFR 797.1400, or OECD Guidelines for Testing of Chemicals, Methods 202 and 203 using test species required by regulatory agencies for permitted discharges. The LC50 concentration, the highest concentration at which 50% of the test species survive, shall be given in milligrams per liter.

3.1.1.3 Trace Contaminants

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

3.1.2 Appearance

The product, as received by the purchaser, shall be homogeneous, uniform in color, and free from skins, lumps, and foreign materials 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 tests on the product in concentrated form as delivered by the vendor, unless otherwise specified herein:

3.2.1 Flash Point

Shall be reported and shall be not lower than 212 °F (100 °C), determined in accordance with ASTM D56 or ASTM D93. In case of dispute, flash point determined in accordance with ASTM D56 shall apply.

3.2.2 Specific Gravity

Shall be reported and shall be within ±0.015 of the preproduction value established in 4.2.3, determined in accordance with ASTM D891.

3.2.3 pH

Shall be 7.0 to 11.5 and within ±0.5 of the preproduction value established in 4.2.3, determined in accordance with ASTM E70.

3.2.4 Freezing Point

3.2.4.1 Freezing point of product diluted 1:1 by weight with ASTM D1193, Type IV water shall be reported and shall be lower than +6 °F (-14.5 °C), determined in accordance with ASTM D1177.

3.2.4.2 Shall be reported and shall be within 7 °F (4 °C) of the preproduction value established in 4.2.3, determined in accordance with ASTM D1177.

3.2.5 Effect on Aircraft Metals

3.2.5.1 Sandwich Corrosion

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

3.2.5.2 Total Immersion Corrosion

The product, tested in accordance with ASTM F483 (except the panels of AMS4376, which shall be tested for 24 hours), shall neither show evidence of corrosion of panels, nor cause 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

3.2.5.3 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.

3.2.5.3.1 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.

3.2.5.3.2

3.2.5.4 Hydrogen Embrittlement

The product shall be nonembrittling, 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).

3.2.5.5 Stress-Corrosion Resistance

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

3.2.5.5.1 Repealed

3.2.6 Effect on Transparent Plastics

3.2.6.1 The product, at 77 °F ± 4 °F (25 °C ± 2 °C), shall not craze, stain, or discolor MIL-PRF-25690 stretched acrylic plastic, determined in accordance with ASTM F484.

3.2.6.2 The product, at 77 °F ± 4 °F (25 °C ± 2 °C), 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 ± 2 minutes to an outer fiber stress of 2000 psi (13.8 MPa).

3.2.7 Effect on Painted Surfaces

The product, at 77 °F ± 4 °F (25 °C ± 2 °C), 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.

3.2.8 Effect on Unpainted Surfaces

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

3.2.9 Rinsibility

The product shall be completely rinsible in tap water, determined in accordance with 3.2.9.1.

3.2.9.1 A 3- x 8-inch (75- x 200-mm) panel of clear glass shall be cleaned to provide a surface free of water break, dried, and coated with the deicing/anti-icing product by pouring the product over the panel while it is held in a horizontal position. The coated panel shall be inclined at an angle of approximately 45 degrees for 10 minutes ± 0.5 minute, then placed in a horizontal position for 24 hours ± 0.25 hour at room temperature. After the 24-hour exposure, the panel shall be rinsed in tap water for 5 to 6 minutes, followed by a rinse with ASTM D1193, Type IV water allowed to air dry at ambient temperature, and examined for visible traces of the deicing/anti-icing product.

3.2.10 Effect on Runway Pavements

3.2.10.1 Runway Concrete Surface Scaling Resistance

The condition of the runway concrete surface shall have a rating not greater than one 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 lb/yd^3 ± 10 lb/yd^3 (302 kg/m^3 ± 6 kg/m^3).

c. Have a slump of 1.5 inches ± 0.5 inch (38 mm ± 13 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.

3.2.10.2 Asphalt Concrete Degradation Resistance

The product 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 mm^{-1} ± 10 mm^{-1} and softening point 102 °F ± 1 °F [39 °C ± 1 °C]) shall be used.

b. Binder content 5.7% by mass.

c. Maximum aggregate size 0.625 inches (16 mm) and distribution as shown in Figure 1.

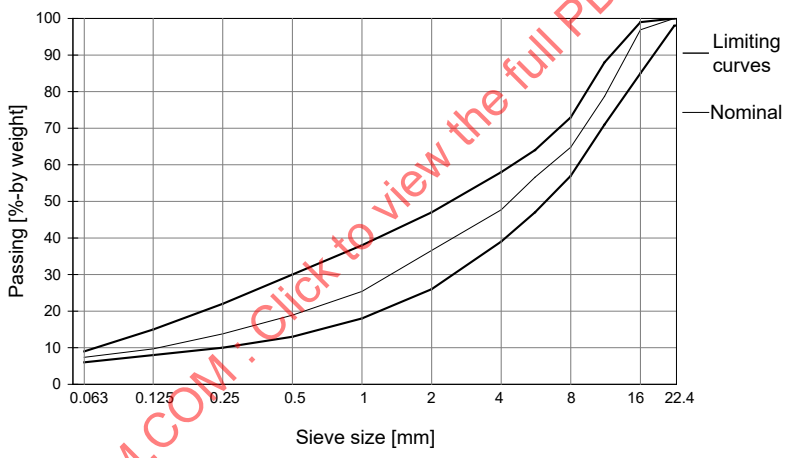

Figure 1 - Aggregate size distribution

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% ± 1% by volume.

f. Specimens are sawed to approximately 1.125 inches (30 mm) thickness.

3.2.11 Storage Stability

The product, after storage in accordance with ASTM F1104, shall not exhibit separation or an increase in turbidity compared to unaged product. Any increase in turbidity shall be reported but shall be acceptable if removed by mild agitation.

3.2.12 Performance

The product, used in accordance with the manufacturer's recommendation, shall remove accumulated frozen deposits of frost and ice from airport aprons (ramps), taxiways, and runways. 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 purchaser and vendor.

3.2.13 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 percent 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 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 the requirements of this specification.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Flash point (see 3.2.1), specific gravity (see 3.2.2), and pH (see 3.2.3) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests

Freezing point (see 3.2.4), effect on aircraft metals (see 3.2.5), effect on transparent plastic (see 3.2.6), effect on painted surfaces (see 3.2.7), effect on unpainted surfaces (see 3.2.8), rinsibility (see 3.2.9), runway concrete surface scaling resistance (see 3.2.10.1), and asphalt concrete degradation resistance (see 3.2.10.2 and Appendix A; valid for deicing/anti-icing products used in Europe) 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 product to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when the purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing

Shall be in accordance with all applicable requirements of 4.3.1 or 4.3.2; a lot shall be all product produced in one continuous manufacturing process from the same batches of raw materials and presented for the vendor's inspection at one time.

4.3.1 Drum Shipments

In accordance with ASTM D1568.

4.3.2 Bulk Shipments

In accordance with ASTM D4057 or ASTM D4177.

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. 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. Production product made by the revised procedure shall not be shipped prior to receipt of reapproval.

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

4.5 Reports

Before the initiaion 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, AMS1435 (latest version), and manufacturing location.

4.5.1 A safety data sheet conforming to ANSI Z400 (superseding AMS2825), or equivalent, 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 the purchaser, concurrent with the first shipment of product for production use. Each request for modification of the product formulation or change in the reportable status of any of the raw materials used 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 containers of a type and size agreed upon by the purchaser and vendor or shall be delivered in bulk.

5.1.2 Each container of product, except for bulk shipments, shall be legibly marked with not less than AMS1435E, the phrase "FOR AIRFIELD USE," the manufacturer's product identification, lot number, purchase order 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, labeling, and transportation of the product to ensure carrier acceptance and safe delivery.

5.1.5 Packaging shall be in accordance with MIL-STD-290, Level C, unless Level A is specified in the request for procurement.

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 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.

8.3 Repealed

8.4 Purchase documents should specify not less than the following:

AMS1435E
Size and type of containers desired
Quantity of product desired
Method of test and acceptance criteria for performance (see 3.2.12)
Level A packaging, if required (see 5.1.5)

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.

PREPARED BY SAE G-12RDP RUNWAY DEICING PRODUCT COMMITTEE