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Date: 06-Oct-2021

SMI/REF: 2104-654

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Product: **D-ICE KA (Date of production: 15.02.2021) (received 18-May-2021)**
Dilution: As received

Partial testing in accordance with:

AMS 1435D (Revised 2018-11)

LIQUID RUNWAY DEICING/ANTI-ICING PRODUCT

3.1 MATERIAL

3.1.1 Environmental Information

3.1.1.1 Biodegradability

Informational

3.1.1.2 Ecological Behavior (LC₅₀)

Informational

3.1.1.3 Trace Contaminants

Informational

3.1.2 Appearance

Conforms

3.2 PROPERTIES

3.2.1 Flash Point

Conforms

3.2.2 Specific Gravity

Informational

3.2.3 pH

Conforms

3.2.4 Freezing Point

Conforms

3.2.5 Effect on Aircraft Metals

3.2.5.1 Sandwich Corrosion

Conforms

3.2.5.2 Total Immersion Corrosion

Conforms

3.2.5.3 Low Embrittling Cadmium Plate

Conforms

3.2.5.3.1 Cyclic Immersion Corrosion of Cadmium Plate

Informational

3.2.5.4 Hydrogen Embrittlement

Conforms

3.2.5.5 Stress-Corrosion Resistance

AMS 4911

Conforms

AMS 4916

Informational

3.2.6 Effect on Transparent Plastics

MIL-P-25690 (Type C)

Conforms

MIL-P-83310 (Polycarbonate)

Conforms

3.2.7 Effect on Painted Surfaces

Conforms

3.2.8 Effect on Unpainted Surfaces

Conforms

3.2.9 Rinsibility

Conforms

3.2.10 Effect on Runway Pavements

Conforms

3.2.10.1 Runway Concrete Scaling Resistance

¹Not performed by SMI

3.2.10.2 Asphalt Concrete Degradation Resistance

In progress

3.2.11 Storage Stability

3.2.12 Performance

Ice Melting Effectiveness

Informational

Ice Undercutting Effectiveness

Informational

Ice Penetration Effectiveness

Informational

3.2.13 Effect on Carbon-Brake Systems

²Not performed by SMI

¹Testing required for deicer /anti-icer products used in Europe (test is not performed by SMI).

²This test is not performed by SMI.

Respectfully submitted,

Patricia D. Viani, SMI Inc.

SCIENTIFIC MATERIAL INTERNATIONAL
www.smiinc.com

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

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

BOD = 0.20 kg O₂/kg fluid

Result Informational

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 chemical oxygen demand (COD), expressed in kilograms of oxygen per kilograms of product.

COD = 0.31 kg O₂/kg fluid

Result Informational

3.1.1.2 Ecological Behavior: A statement of the ecological behavior of the product, which 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 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.

EPA 40 CFR 797.1300 DAPHNID ACUTE TOXICITY TEST

Daphnia magna, static system
48 hour LC₅₀: 725 mg/L

EPA 40 CFR 797.1400 FISH ACUTE TOXICITY TEST

Pimephales promelas, static system
96 hour LC₅₀: 2,125 mg/L

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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).

Sulfur:	< 1 ppm	(< 0.0001 %)
Halogens:	< 10 ppm	(< 0.0010 %)
Phosphate (P as P₂O₅):	7 ppm	(0.0007 %)
Nitrate (as NO₃):	< 2 ppm	(< 0.0002 %)

Heavy Metals:

Lead (Pb):	< 1 ppm	(< 0.0001 %)
Chromium (Cr):	< 1 ppm	(< 0.0001 %)
Cadmium (Cd):	< 1 ppm	(< 0.0001 %)
Mercury (Hg):	< 1 ppm	(< 0.0001 %)

Result Informational

3.1.2 Appearance: Product, as received by 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.

Product is clear like water; uniform and homogeneous; and exhibits no precipitate.

Result Conforms

3.2. Physical Properties: The product, as supplied by 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 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.

No flash to 212°F

Result Conforms

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.

1.280 @ 60/60°F

Result Informational

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.

"Shall be 7.0 to 11.5 ..." pH: 10.7

Result Conforms

"...and within ± 0.5 of the preproduction value established in 4.2.3, determined in accordance with ASTM E 70".

pH: 10.7

Result Informational

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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.

Freezing point (fluid diluted 1:1): -15°C (5°F)

Result Conforms

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.

Freezing point (fluid diluted 1:1): -15°C (5°F)

Result Informational

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 1.

	2024-T3 Bare Anodized	2024-T3 Alclad	7075-T6 Bare Anodized	7075-T6 Alclad
PRODUCT (AS RECEIVED)	1	1	1	1
CONTROL	1	1	1	1

Result Conforms

3.2.5.2 **Total Immersion Corrosion:** The product, tested in accordance with ASTM F483 (except that panels of AMS4376 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.

TEST PANEL	WEIGHT CHANGE (mg/cm ² /24hrs)	
	ALLOWABLE	RESULTS
AMS 4037 aluminum alloy, anodized as in AMS 2470	0.3	0.02
AMS 4041 aluminum alloy	0.3	0.02
AMS 4049 aluminum alloy	0.3	+ 0.01
AMS 4376 magnesium alloy, dichromate treated as in AMS 2475 (tested for 24 hours only)	0.2	+ 0.04
AMS 4911 titanium alloy	0.1	+ 0.01
AMS 5045 Carbon Steel	0.8	0.01

“+” indicates weight gain

Result Conforms

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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/cm² per 24hrs, determined in accordance with ASTM F1111.

As received: 0.01 mg/cm²/24hrs

Result Conforms

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.

Initial pH of solution: 10.7

Final pH of solution: 10.4

PANEL WEIGHTS	REPLICATE #	Weight (g)		
		Initial	Final	Weight change
	1	16.4558	16.4581	+ 0.0023
	2	16.2483	16.2590	+ 0.0107
	3	16.4343	16.4376	+ 0.0033
Average weight change = + 0.0054 g (+ 0.19 mg/cm ²) Note: "+" indicates weight gain				
<i>AIR6130A: A runway deicing fluid or solid compound tested in accordance with this document that exhibits a weight loss of more than 0.3 mg/cm² may cause undesirable corrosion effects to airplane equipment and/or airport equipment.</i>				
Result: *Informational				
See separate report for complete data tables				

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3.2.5.4 Hydrogen Embrittlement: The 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 specimen, shall be immersed continuously in the solution under test for 150 hours at a temperature of $77^{\circ}\text{F} \pm 9^{\circ}\text{F}$ ($25^{\circ}\text{C} \pm 5^{\circ}\text{C}$).

Specimens: Type 1c:
As received: #1: No failure within 150 hours
#2: No failure within 150 hours
#3: No failure within 150 hours
#4: No failure within 150 hours

Result Conforms

3.2.5.5 Stress-Corrosion Resistance: The product shall not cause cracks in AMS 4911 titanium alloy specimens, determined in accordance with ASTM F945, Method A.

AMS 4911: No cracking evident.

Result Conforms

3.2.5.5.1 The product shall be tested in accordance with ASTM F945, Method A using AMS4916 specimens. Report shall detail the effect of the product and the effect of control solution. The results shall be reported for informational purposes only.

AMS 4916: Cracking evident.

Result Informational

3.2.6 Effect on Transparent Plastics:

3.2.6.1 The product, at $77^{\circ}\text{F} \pm 4^{\circ}\text{F}$ ($25^{\circ}\text{C} \pm 2^{\circ}\text{C}$), shall not craze, stain, or discolor MIL-PRF-25690 stretched acrylic plastic, determined in accordance with ASTM F484.

Result Conforms

3.2.6.2 The product, at $77^{\circ}\text{F} \pm 4^{\circ}\text{F}$ ($25^{\circ}\text{C} \pm 2^{\circ}\text{C}$), 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 \pm 2 minutes to an outer fiber stress of 2000 psi (13.8 MPa).

Result Conforms

3.2.7 Effect on Painted Surfaces: The product, at $77^{\circ}\text{F} \pm 4^{\circ}\text{F}$ ($25^{\circ}\text{C} \pm 2^{\circ}\text{C}$), 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.

Result Conforms

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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.

Result Conforms

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 waterbreak, dried, and coated with the deicer/anti-icer 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 \pm 0.5 minute, then placed in a horizontal position for 24 hours \pm 0.25 hour at room temperature. After the 24 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 deicer/anti-icer product.

Result Conforms

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 C 672
- b. Have a minimum cement content of 510 lb/yd³ \pm 10 lb/yd³ (302 kg/m³ \pm 6 kg/m³)
- c. Have a slump, 1.5 inches \pm 0.5 inch (38 mm \pm 13 mm).

A 25 % by volume solution of the deicer/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.

Rating: 1

Result Conforms

3.2.10.2 Asphalt Concrete Degradation Resistance (Appendix A, valid for deicer/anti-icer products used in Europe)

Result *Not performed by SMI

***Testing required for deicer /anti-icer products used in Europe. This test is not performed by SMI.**

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.

Requires one year of storage

Result In progress (due May 2022)

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3.2.12 **Performance:** The product, used in accordance with manufacturer's recommendation, shall remove accumulated frozen deposits of frost and ice from airport aprons (ramps), taxiways and runways. The fluid shall be tested in accordance with AIR6170 for ice melting effectiveness, with AIR6172 for ice undercutting effectiveness, and with AIR6211 for ice penetration effectiveness. Acceptance criteria shall be agreed upon by purchaser and vendor.

SAE AIR6170

Ice Melting Test Method for Runways and Taxiways Deicing / Anti-icing Chemicals

See separate report for complete data results

ICE MELTING TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification: D-ICE KA (Date of production: 15.02.2021)			
Test Temperature: -10°C (+14°F)			
Time (minute)	Mean Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mean Mass of Ice Melted M_{im} (g)	Ice Melting Capacity (m_{im}/m_d)
5	5.0	3.1	0.6
10	5.0	5.1	1.0
30	5.0	6.9	1.4

Runway Deicing/Anti-icing Chemical Identification: D-ICE KA (Date of production: 15.02.2021)			
Test Temperature: -2°C (+28°F)			
Time (minute)	Mean Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mean Mass of Ice Melted M_{im} (g)	Ice Melting Capacity (m_{im}/m_d)
5	5.0	7.2	1.4
10	5.0	7.3	1.5
30	5.0	8.6	1.7

Client: Nordix Chemicals Factory d.o.o.
 Product: **D-ICE KA (Date of production: 15.02.2021)**
 Dilution: As received
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3.2.12 Performance (continued):

SAE AIR6172

Ice Undercutting Test Method for Runways and Taxiways Deicing/Anti-icing Chemicals

See separate report for complete data results

ICE UNDERCUTTING TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification: D-ICE KA (Date of production: 15.02.2021)		Test Temperature: -10°C (+14°F)		
Time (minute)	Mean Undercut Cavity Diameter (mm)	Total Area IU _e (mm ²)	Area Original Cavity A _s (mm ²)	Ice Undercutting IU (mm ²)
5	6.4	32.4	7.1	25.3
10	7.2	41.2	7.1	34.1
30	7.7	46.8	7.1	39.7

Runway Deicing/Anti-icing Chemical Identification: D-ICE KA (Date of production: 15.02.2021)		Test Temperature: -2°C (+28°F)		
Time (minute)	Mean Undercut Cavity Diameter (mm)	Total Area IU _e (mm ²)	Area Original Cavity A _s (mm ²)	Ice Undercutting IU (mm ²)
5	7.5	43.9	7.1	36.9
10	8.2	53.0	7.1	45.9
30	9.5	71.1	7.1	64.1

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3.2.12 Performance (continued):

SAE AIR6211

Ice Penetration test Method for Runways and Taxiways Deicing/Anti-icing Chemicals

See separate report for complete data results

ICE PENETRATION TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification: D-ICE KA (Date of production: 15.02.2021)	
Test Temperature -10°C (+14°F) :	
Time (minutes)	Penetration Depth (mm) Average
5	2.0 mm
10	3.0 mm
30	3.5 mm

Runway Deicing/Anti-icing Chemical Identification: D-ICE KA (Date of production: 15.02.2021)	
Test Temperature -2°C (28.4°F) :	
Time (minutes)	Penetration Depth (mm) Average
5	2.0 mm
10	3.5 mm
30	6.0 mm

Client: Nordix Chemicals Factory d.o.o.
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3.2.12 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.

Result ²Not performed by SMI

² This test is not performed by SMI.