

Attn: Sergii Ezhov
DR Energy Group
31b Dragomanova str.
02068 Kiev Ukraine

Date: 26-Feb-2020

SMI/REF: 1911-204

Product: **RUNWAY GUARD - KF** (received 06-Dec-2019)

Dilution: As received

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Periodic testing in accordance with
AMS 1435D (Revised 2018-11)
LIQUID RUNWAY DEICING/ANTI-ICING PRODUCT

4.2.2 Periodic Tests

3.2.4	Freezing Point	<u>Conforms</u>
3.2.5	Effect on Aircraft Metals	
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3.2.5.4	Hydrogen Embrittlement	<u>Conforms</u>
3.2.5.5	Stress-Corrosion Resistance	
	AMS 4911	<u>Conforms</u>
	AMS 4916	<u>Informational</u>
3.2.6	Effect on Transparent Plastics	
	MIL-P-25690 (Type C)	<u>Conforms</u>
	MIL-P-83310 (Polycarbonate)	<u>Conforms</u>
3.2.7	Effect on Painted Surfaces	<u>Conforms</u>
3.2.8	Effect on Unpainted Surfaces	<u>Conforms</u>
3.2.9	Rinsibility	<u>Conforms</u>
3.2.10	Effect on Runway Pavements	
3.2.10.1	Runway Concrete Scaling Resistance	<u>Conforms</u>
3.2.10.2	Asphalt Concrete Degradation Resistance	<u>*Not performed by SMI</u>

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

Respectfully submitted,



Patricia D. Viani, SMI Inc.

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4.2.2 **Periodic Tests:** Freezing point (3.2.4), effect on aircraft metals (3.2.5), effect on transparent plastic (3.2.6), effect on painted surfaces (3.2.7), effect on unpainted surfaces (3.2.8), rinsibility (3.2.9), runway concrete scaling resistance (3.2.10.1) and asphalt concrete degradation resistance (3.2.10.2 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 four calendar years.

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 (1:1 dilution): -15 °C

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 (1:1 dilution): -15 °C

Result Informational

3.2.5 **Effect on Aircraft Metals:**

3.2.5.1 **Sandwich Corrosion:** Specimens, after testing in accordance with ASTM F 1110, shall show a rating not greater (worse) than one.

	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

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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	< 0.01
AMS 4041 aluminum alloy	0.3	0.04
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	+ 0.02
AMS 4911 titanium alloy	0.1	0.01
AMS 5045 Carbon Steel	0.8	< 0.01

"+" indicates weight gain

Result Conforms

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: + 0.05 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 AIR6130A.

Initial pH of solution: 10.5 Final pH of solution: 9.9

PANEL WEIGHTS	REPLICATE #	Weight (g)		
		Initial	Final	Weight change
	1	10.4415	10.4431	+ 0.0016
	2	10.2824	10.2851	+ 0.0027
	3	10.3081	10.3119	+ 0.0038
Average weight change = + 0.0027 g (+ 0.10 mg/cm²)				
Note: "+" indicates weight gain				

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.

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°F ± 9°F (25°C ± 5°C).

Specimens: Type 1c:

*As received: #1: No failure occurred within 150 hours
#2: No failure occurred within 150 hours
#3: No failure occurred within 150 hours
#4: No failure occurred 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.

As received: 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.

As received: Cracking evident.

Result Informational

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.

Result Conforms

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).

Result Conforms

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

Result Conforms

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 $510 \text{ lb/yd}^3 \pm 10 \text{ lb/yd}^3$ ($302 \text{ kg/m}^3 \pm 6 \text{ kg/m}^3$)
- c. Have a slump, 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.SMI.**

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Testing in accordance with
SAE AIR6130A
CADMIUM PLATE CYCLIC CORROSION TEST (2017-05)

Cadmium Plate Cyclic Corrosion Test

Initial pH of solution: 10.5 Final pH of solution: 9.9

Replicate	Initial (g)	Final (g)	Weight change (grams)
1	10.4415	10.4431	+ 0.0016
2	10.2824	12.6072	+ 0.0027
3	10.3081	10.3119	+ 0.0038
Average weight change = + 0.0027 g (+ 0.10 mg/cm²) Note: "+" indicates weight gain			

AIR6130A states: 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.

Result Informational

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SAE AIR6130A, Cadmium Plate Cyclic Corrosion Test

Cadmium Plate Cyclic Corrosion Test

AMS 1431 Compound, Solid Runway and Taxiway Deicing/Anti-Icing

AMS 1435 Fluid, Generic, Deicing/Anti-Icing Runways and Taxiways

3 Test Specimen Preparation

Substrate: 4130 Steel

Size: 1" x 2" x 0.04" x 0.048" (25.40 mm x 50.80 mm x 1.22 mm)

Finish: Cadmium plating in accordance with AMS QQ-P-416., Type I Class I, (0.0005"- 0.0008" inch plating per side).

There shall be no supplementary chromate treatment.

- a. Three cadmium plated test specimens shall be used for each fluid to be tested
- b. Sample of AMS1435 Runway Deicing Fluid shall be tested as received from the supplier.
- c. Sample of AMS1431 Runway Deicing Solid Compound shall be tested in a diluted form – diluted with ASTM D 1193, Type IV, water to 15% by weight solids.
- d. Procure soft flexible brushes for test (paintbrush type, 1.5 inches (3.8 cm) wide, with synthetic bristles approx 1.5 inches (3.8 cm) long

4 Environmental Exposure Preparation

Preset humidity chamber to $90 \pm 5^\circ\text{F}$ and $30 \pm 5\%$ humidity. Affix plastic ties or other inert material as hangers (hangers shall be made from an inert material that will not react with the sample; plastic, plastic coated metals, monofilament fishing line or stainless steels are acceptable) in the chamber to hold specimens during the environmental exposure period.

5 Test Procedure

- a. Measure and record pH of solution(s) to be tested (record to one decimal place).
- b. Solvent clean cadmium plated specimens with acetone; wipe gently with an acetone-soaked wiper. Without allowing the acetone to evaporate, gently remove excess acetone with a dry wiper. Allow samples to dry for 10 minutes in a desiccator. Do not accelerate drying of samples with oven drying.

Note: Care should be taken not to touch the cleaned specimens with bare hands; use tweezers, clean gloves or equivalent tool.

- c. Weigh and record initial specimen weight in grams. Record all weights throughout the test to the nearest 0.0001 gram. Return specimens to desiccator until Day 3.

Monday	Tuesday	Wednesday	Thursday	Friday
				Friday Start – Day 0
Day 3	Day 4	Day 5	Day 6	Day 7
Day 10	Day 11	Day 12	Day 13	Day 14

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- d. FRIDAY START - Fill glass containers with solution to be tested, one container for each coupon. Refer to 3b or 3c for solution being used (consider filling one extra container to have extra conditioned fluid available). Container shall be large enough so the solution completely covers the specimens. Cover the container with loose fitting cover and place filled container into the humidity chamber to environmentally condition the solution for a minimum of 24 ± 1 hours before the start of test, up to 72 ± 1 hours.
- e. Day 3 – Remove the solution container from the humidity chamber and the specimens from the desiccator. Place specimens in container oriented such that the specimens are not resting flush against the bottom or side of the container. Place the container with cover back into the humidity chamber for 24 ± 1 hours.
- f. Day 4 - After the 24 hour immersion in the solution, remove the specimens, but do not rinse them. Place them into the humidity chamber by hanging for 22.5 ± 0.5 hours. Hangers shall be made from an inert material that will not react with the sample (such as plastic, plastic coated metals and stainless steels are acceptable).
- g. Day 5 /Day 10 /Day 12 – Remove the specimens from the humidity chamber. Rinse the specimens with deionized water. Lightly brush (12 strokes per side) the specimen surface with the soft flexible brush while rinsing to remove loose corrosion products. Immerse samples into acetone for 10 seconds while agitating specimen. Allow samples to dry for 10 minutes in a desiccator. Weigh and record the specimen weights. Do not accelerate drying of samples with oven drying.

Note: If multiple solutions are being tested, use different brushes for each solution to avoid cross contamination.

Immediately after weighing the specimens, return them to their test solution container to soak for 90 ± 5 minutes in the humidity chamber. Specimens shall be oriented such that they not resting flush against the bottom or side of the container. After 90 minutes, remove the specimens but do not rinse them. Place them in the humidity chamber by hanging for 22.5 ± 0.5 hours, maintaining the specimen in the initial orientation throughout the cycle.

- h. Day 6 /Day 11 /Day 13 - Return the specimen to the test solution container to soak for 90 ± 5 minutes in the humidity chamber. Specimens shall be oriented such that it is not resting flush against the bottom or side of the container. After 90 minutes, remove the specimen but do not rinse it. Replace it in the humidity chamber by hanging for 22.5 ± 0.5 hours, maintaining the specimen in the initial orientation throughout the cycle.
- i. Day 7 – Remove specimens from the humidity chamber. Rinse the specimens with deionized water. Lightly brush (12 strokes per side) the specimens surface with a soft flexible brush while rinsing to remove loose corrosion products. Immerse samples into acetone for 10 seconds while agitating specimen. Allow samples to dry for 10 minutes in a desiccator. Weigh and record the specimen weights. Do not accelerate drying of samples with oven drying.

Note: If multiple solutions are being tested, use different brushes for each solution to avoid cross contamination.

Immediately after weighing the specimens, return them to their test solution container in the humidity chamber. Specimens shall be oriented such that they are not resting flush against the bottom or side of the container. Specimens shall be left in the test solution container in the humidity chamber from DAY 7 to DAY 10.

SAE AIR6130A, Cadmium Plate Cyclic Corrosion Test

- j. **Day 14** – Remove specimens from the humidity chamber. Rinse the specimens with deionized water. Lightly brush (12 strokes per side) the specimen surface with a soft flexible brush while rinsing to remove loose corrosion products. Immerse samples into acetone for 10 seconds while agitating specimen. Allow samples to dry for 10 minutes in a desiccator. Weigh and record the specimen weights. Do not accelerate drying of samples with oven drying.

Note: If multiple solutions are being tested, use different brushes for each solution to avoid cross contamination.

- k. Measure and record final pH of solution (record to one decimal place).
- l. Report the initial weight of the specimen, the weight after each periodic weighing, and the final weight. Calculate and report the value of the cumulative weight lost from each specimen after each periodic weighing procedure.

Test Data:

pH at start of test: 10.5
pH at end of test: 9.9

INITIAL PANEL WEIGHTS	REPLICATE #	Weight (g)
	1	10.4415
	2	10.2824
	3	10.3081

WEEK #1 PANEL WEIGHTS	REPLICATE #	Weight (g)		
		Monday	Wednesday	Friday
	1	----	10.4437	10.4436
	2	----	10.2856	10.2850
	3	----	10.3128	10.3120

WEEK #2 PANEL WEIGHTS	REPLICATE #	Weight (g)		
		Monday	Wednesday	Friday
	1	10.4439	10.4419	10.4431
	2	10.2854	10.2837	10.2851
	3	10.3124	10.3103	10.3119

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TEST DATA (continued)

REPLICATE #1	INITIAL WEIGHT (grams)	WEEK 1 WED (grams)	WEEK 1 FRI (grams)	WEEK 2 MON (grams)	WEEK 2 WED (grams)	WEEK 2 FRI (grams)
	10.4415	10.4437	10.4436	10.4439	10.4419	10.4431
CUMULATIVE WEIGHT CHANGE ("+" indicates weight gain)	--	+ 0.0022	+ 0.0021	+ 0.0024	+ 0.0004	+ 0.0016 (FINAL)

REPLICATE #2	INITIAL WEIGHT	WEEK 1 WED	WEEK 1 FRI	WEEK 2 MON	WEEK 2 WED	WEEK 2 FRI (FINAL WEIGHT)
	10.2824	10.2856	10.2850	10.2854	10.2837	10.2851
CUMULATIVE WEIGHT CHANGE ("+" indicates weight gain)	--	+ 0.0032	+ 0.0026	+ 0.0030	+ 0.0013	+ 0.0027 (FINAL)

REPLICATE #3	INITIAL WEIGHT	WEEK 1 WED	WEEK 1 FRI	WEEK 2 MON	WEEK 2 WED	WEEK 2 FRI (FINAL WEIGHT)
	10.3081	10.3128	10.3120	10.3124	10.3103	10.3119
CUMULATIVE WEIGHT CHANGE ("+" indicates weight gain)	--	+ 0.0047	+ 0.0039	+ 0.0043	+ 0.0022	+ 0.0038 (FINAL)

SUMMARY:

WEIGHT CHANGE	REPLICATE #	Weight Change (g)	Average Weight Change	Informational
	1	+ 0.0016	+ 0.10mg/cm² (+ 0.0027 g)	
	2	+ 0.0027		
	3	+ 0.0038		

Note: "+" indicates a weight gain.

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.

Respectfully Submitted,

Patricia D. Viani, SMI Inc.