SMI, Inc.
12219 SW 131 Avenue
Miami, Florida 33186-6401 USA
Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Dominic Steffen
Xynyth Manufacturing Corp
122-3989 Henning Drive
Burnaby BC Canada

Date: 15-Jan-2014

SMI REF: 1308-932$_{R2}$

Product: **WINTER WARRIOR RUNWAY CONTROL** *(received 06-Sep-2013)*

Dilution: Per specification

AMS 1431D
COMPOUND, SOLID RUNWAY AND TAXIWAY DEICING/ANTI-ICING

3.1	Material	
3.1.1	Environmental Information	
3.1.1.1	Biochemical Oxygen Demand	Informational
3.1.1.2	Chemical Oxygen Demand	Informational
3.1.1.3	Percent Biodegradation	Informational
3.1.1.4	Aquatic Toxicity	Informational
3.1.2	Trace Contaminants	Informational
3.1.3	Water Content	Informational
3.1.4	Freezing Point	Informational
3.1.5	Appearance	Conforms
3.2	PROPERTIES	
3.2.1	pH	Informational
3.2.2	Flash Point	Conforms
3.2.3	Chloride Content	Conforms
3.2.4	Storage Stability	Not performed
3.2.5	Effect on Transparent Plastics	Conforms
3.2.6	Effect on Painted Surfaces	Conforms
3.2.7	Effect on Unpainted Surfaces	Conforms
3.2.8	Effect on Runway Pavements	
3.2.8.1	Runway Concrete Surface Scaling Resistance	Conforms
3.2.8.2	Asphalt Concrete Degradation Resistance	[1]Not performed by SMI
3.2.9	Effect on Aircraft Metals:	
3.2.9.1	Sandwich Corrosion	Conforms
3.2.9.2	Total Immersion Corrosion	Conforms
3.2.9.3	Low Embrittling Cadmium Plate	Conforms
3.2.9.3.1	Cyclic Immersion Corrosion of Cadmium Plate	Informational
3.2.9.4	Hydrogen Embrittlement	Conforms
3.2.9.5	Stress Corrosion Resistance	
	AMS 4911	Conforms
	AMS 4916	Informational

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

3.2 PROPERTIES *(continued)*

3.2.10 Performance

Ice Melting Effectiveness	Informational
Ice Undercutting Effectiveness	Informational
Ice Penetration Effectiveness	Informational

3.2.11 Effect on Carbon-Brake Systems — [2]Not performed by SMI

[2] *This test is not performed by SMI.*

Respectfully submitted,

Patricia D. Viani, SMI Inc.

3.1 Material:

3.1.1 Environmental Information: Compound 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 compound for 5, 15, and 20-day incubation periods. The test solutions shall be incubated at 20°C (68°F).

5 day BOD: 0.12 kg O_2/kg solid
15 day BOD: 0.13 kg O_2/kg solid
20 day BOD: 0.13 kg O_2/kg solid

Result Informational

3.1.1.2 Total Oxygen Demand (TOD) or Chemical Oxygen Demand (COD) of the compound, expressed in kilograms of oxygen per kilograms of compound.

COD: 0.42 kg O_2/kg solid

Result Informational

3.1.1.3 Percent biodegradation of compound for 5, 15, and 20 day incubation periods. Percent biodegradation can be approximated by dividing BODx100 by either TOD or COD.

5 day = (0.12 x 100) / 0.42) = 29%
15 day = (0.13 x 100) / 0.42) = 31%
20 day = (0.13 x 100) / 0.42) = 31%

Result Informational

3.1.1.4 Aquatic Toxicity: Formulated compound shall be tested in accordance with EPA (40 Code of Federal Regulations (CFR) Parts 797.1300 and 797.1400) or OECD (Organization for Economic Cooperation and Development 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 LC_{50} 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 LC_{50}: 2,225 mg/L

EPA 40 CFR 797.1400 FISH ACUTE TOXICITY TEST
Pimephales promelas, static system
96 hour LC_{50}: 4,250 mg/L

Result Informational

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). *Tested using a 15 % solution:*

Sulfur:	***4 ppm***	***(0.0004 %)***
Halogens:	***< 10 ppm***	***(< 0.0010 %)***
Phosphate (P as P_2O_5):	***2609 ppm***	***(0.2609 %)***
Nitrate (as NO_3):	***< 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

3.1.3 Vendor shall report the product chemical analysis, determined in accordance with a recognized method acceptable to purchaser; and total water content shall be determined in accordance with ASTM E 203.

Water Content: < 2%

Result Informational

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

Freezing point (5% solution):	***- 2 °C***
Freezing point (10% solution):	***- 4 °C***
Freezing point (15% solution):	***- 8 °C***

Result Informational

3.1.5 Appearance: The compound, as received by purchaser, shall be uniform, free-flowing, and free from foreign material detrimental to usage of the compound.

Compound is uniform and free from foreign material.

Result Conforms

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

3.2.1 pH: The compound, diluted with ASTM D 1193, Type IV water, to 15% by weight of solids taking into account water contained in the compound, shall be within ± 0.5 of the preproduction value established in 4.2.3, determined in accordance with ASTM E 70.

15%: pH = 10.8

Result Informational

3.2.2 Flash Point: The compound on a dry basis shall be not lower than 93°C (200°F), determined in accordance with ASTM D 56.

As received (dry basis): No flash to 212°F

Result Conforms

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 112A.

As received (dry basis): Chloride content = 53 ppm

Result Conforms

3.2.4 Storage Stability: The compound, when stored in a closed container for at least one year in accordance with ASTM F 1104 shall not deliquesce or otherwise deteriorate.

Result Not performed

3.2.5 Effect on Transparent Plastics:

3.2.5.1 The compound, diluted with ASTM D 1193, Type IV, water to 15% by weight of solids taking into account water contained in the compound shall not craze, stain or discolor Type C stretched acrylic plastic conforming to MIL-P-23690, determined in accordance with ASTM F 484

15%: Type C – no crazing, staining or discoloration

Result Conforms

3.2.5 Effect on Transparent Plastics (continued):

3.2.5.1 The compound, diluted with ASTM D 1193, Type IV, water to 15% by weight of solids taking into account water contained in the compound, shall not craze, stain, or discolor MIL-P-83310 polycarbonate plastic, determined in accordance with ASTM F 484, except that the specimens shall be stressed for 30 minutes ± 2 to an outer fiber stress 13.8 Mpa (2000 psi).

15%: MIL-P-83310 – no crazing, staining or discoloration

Result Conforms

3.2.6 Effect on Painted Surfaces: Compound, diluted with ASTM D 1193, Type IV, water to 15% by weight of solids taking into account water contained in the compound, 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 F 502.

15%: No hardness change; no streaking, discoloration or blistering

Result Conforms

3.2.7 Effect on Unpainted Surfaces: Compound, diluted with ASTM D 1193, Type IV, water to 15% by weight of solids taking into account water contained in the compound, shall neither produce streaking nor leave any stains which require polishing to remove, determined in accordance with ASTM F 485.

15%: No streaking, no staining

Result Conforms

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 C 672, except that concrete shall

* Be air-entrained with an air content as specified in ASTM C 672. Have a minimum cement content of 302 kg/m^3 ± 6 (510 lb/yd^3 ± 10). Have a slump, 38 mm ± 13 (1.5 inches ± 0.5).
* A 25% by volume solution of the deicer/anti-icer fluid 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.
  Note: a 25% by weight saturated solution was utilized for testing

Rating after 50 cycles: 1

Result Conforms

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

Result [1]Not performed by SMI

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

3.2.9 Effect on Aircraft Metals: Compound, diluted with ASTM D 1193, Type IV, water to 5% and 15% by weight solids taking into account water contained in the compound, shall meet the following requirements:

3.2.9.1 Sandwich Corrosion: Specimens, after testing in accordance with ASTM F 1110, shall show corrosion not worse than control panels run using ASTM D 1193, Type IV water.

	2024-T3 Bare Anodized	2024-T3 Alclad	7075-T6 Bare Anodized	7075-T6 Alclad
5 PERCENT	**1**	**1**	**1**	**1**
15 PERCENT	**1**	**1**	**1**	**1**
CONTROL	1	1	1	1

Result Conforms

3.2.9.2 Total Immersion Corrosion: The compound, tested in accordance with ASTM F 483, except that panels shall be AMS 4376 tested for 24 hours, shall neither cause corrosion of test panels nor a weight change of any test panel greater than shown in Table I.

ALLOY	WEIGHT LOSS mg/cm^2/24hrs		
	Allowed	**5 %**	**15 %**
AMS 4037 Aluminum anodized per AMS 2470	0.3	**+ 0.04**	**+ 0.03**
AMS 4041 Aluminum	0.3	**0.01**	**0.01**
AMS 4049 Aluminum	0.3	**< 0.01**	**< 0.01**
AMS 4376 Magnesium, dichromate (AMS 2475)	0.2	**0.17**	**0.03**
AMS 4911 Titanium	0.1	**< 0.01**	**< 0.01**
AMS 5045 Carbon Steel	0.8	**0.09**	**0.06**

Result Conforms

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/cm^2 24 hours, determined in accordance with ASTM F 1111.

5%: 0.02 mg/cm^2 / 24 hrs
15%: < 0.01 mg/cm^2 / 24 hrs

Result Conforms

3.2.9.3.1 The compound shall be tested for cyclic immersion corrosion of cadmium plate in accordance with AIR6130 and the results reported as specified in Section 4 of AIR6130.

Cadmium Plate Cyclic Corrosion Test

Initial pH of solution: 10.8 **Final pH of solution**: 9.0

Note: Solution tested = 15% w/w

	REPLICATE #	Weight (g)		
		Initial	Final	**Weight change**
PANEL WEIGHTS	1	13.6035	13.5947	**0.0088**
	2	13.5432	13.5350	**0.0082**
	3	13.6077	13.5992	**0.0085**

****A runway deicing fluid or solid compound tested in accordance with this document that exhibits a weight loss of more than 0.3 mg/cm^2 (total weight loss more than 0.0077 g for the standard 1 x 2 inch cadmium plated specimen) may cause undesirable corrosion effects to airplane equipment and/or airport equipment.***

("+" indicates weight gain)

Average weight change = 0.0085 g per panel (0.30 mg/cm^2)

Result: ***Informational**

3.2.9.4 Hydrogen Embrittlement: The diluted compound shall be non-embrittling, determined in accordance with ASTM F 519, Type 1a, 1c, or 2a.

Specimens: Four Type 1c, cadmium plated per MIL-STD-870.
Load: 45%, immersed for duration, 150 hours, temperature 23°C + 2°C.

Type 1c @ 5%: ***No failures occurred within 150 hours.***
Type 1c @ 15%: ***No failures occurred within 150 hours.***

Result Conforms

3.2.9.5 Stress-Corrosion Resistance: The diluted compound shall not cause cracks in AMS 4911 Titanium alloy, determined in accordance with ASTM F 945, Method A.

5 %: AMS 4911: ***No cracking observed***
15 %: AMS 4911: ***No cracking observed***

Result Conforms

3.2.9.5.1 Stress Corrosion Resistance: The diluted compound shall be tested in accordance with ASTM F 945, Method A using AMS 4916 specimens. The results obtained from AMS 4916 shall be reported for informational purposes only.

5 %: AMS 4916: ***Cracking observed***
15 %: AMS 4916: ***Cracking observed***

Result Informational

3.2.10 Performance: The compound, used in accordance with manufacturer's recommendation, shall remove accumulated frozen deposits of frost and ice from aircraft maneuvering areas, such as airport aprons, runways and taxiways. The compound 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 and method of test shall be agreed upon by purchaser and vendor

SAE AIR6170 (2012-01)

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

See separate report for complete data results

As received (solid): ***ICE MELTING TEST RESULTS***

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**			
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	3.0	0.6
10	5.0	5.1	1.0
30	5.0	9.0	1.8

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**			
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	2.7	0.5
10	5.0	3.3	0.7
30	5.0	4.0	0.8

SAE AIR6170 (2012-01)

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

See separate report for complete data results

25% w/w: ***ICE MELTING TEST RESULTS***

Runway Deicing/Anti-icing Chemical Identification:
WINTER WARRIOR RUNWAY CONTROL

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	0.7	0.1
10	5.0	0.9	0.2
30	5.0	0.9	0.2

Runway Deicing/Anti-icing Chemical Identification:
WINTER WARRIOR RUNWAY CONTROL

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	0.8	0.2
10	5.0	1.9	0.4
30	5.0	4.4	0.9

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: **WINTER WARRIOR RUNWAY CONTROL**		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	9.4	69.4	7.1	62.3
10	9.5	70.9	7.1	63.8
30	9.4	69.4	7.1	62.3

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**		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	8.1	51.5	7.1	44.4
10	8.2	52.8	7.1	45.7
30	8.6	58.1	7.1	51.0

3.2.1 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: **WINTER WARRIOR RUNWAY CONTROL**	
Test Temperature **-10^{0}C (+14^{0}F)**:	
Time (minutes)	Penetration Depth (mm) Average
5	**1.5 mm**
10	**2.0 mm**
30	**2.5 mm**

3.2.11 Effect on Carbon-Brake Systems: The compound shall be tested for catalytic oxidation of carbon in accordance with AIR5567 and the results shall be reported as shown in section 4.2 of AIR5567. The results shall be reported for informational purposes only

Result [2]Not performed by SMI

[2] *This test is not performed by SMI.*

SMI, Inc.
12219 SW 131 Avenue
Miami, Florida 33186-6401 USA
Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Dominic Steffen
Xynyth Manufacturing Corp
122-3989 Henning Drive
Burnaby BC Canada

Date: 15-Jan-2014

SMI REF: 1308-932$_{R2}$

Product: **WINTER WARRIOR RUNWAY CONTROL** *(received 06-Sep-2013)*

Dilution: 25% w/w

Testing in accordance with
SAE AIR6170
Ice Melting Test Method for Runways and Taxiways
Deicing/Anti-icing Chemicals (2012-01)

3.0 SUMMARY OF TEST METHOD:

3.1 The test utilizes a sheet of ice of uniform thickness frozen in a flat circular polystyrene petri dish. After equilibration to the desired temperature, a weighed quantity of the deicing chemical is distributed over the surface of the ice. At specified time intervals, generated brines are removed and the mass difference is calculated in order to obtain the mass of melted ice. Test temperatures shall be within 1°C (2°F) of the stated values and tests shall be performed within a freezer or cold chamber.

3.2 This test method provides a means to evaluate and compare the ice melting capabilities of ready-to-use runway deicing/anti-icing chemicals in liquid or solid form over limited, defined time intervals at specified temperatures.

Solid Runway Deicing/Anti-icing Chemical
The solid deicing/anti-icing chemical shall be tested in both "as is" and diluted forms (25% w/w solution)

3.8 Data Recording and Reporting

The amount of ice melted shall be recorded for each temperature for the time intervals of 5, 10 and 30 minutes and reported, for example see Table 1 (additional time intervals can be gathered upon request). The recorded value for each temperature/time observation shall be the average of the three tests. All data is measured in gram (g) and rounded to the nearest tenth of a gram (0.1 g).

The ice melting capacity is calculated and recorded. The unit is expressed in terms of "grams of ice melted per gram of deicing/anti-icing chemical applied". Present the graph of the amount of ice melted as a function of time

Table 1 – ICE MELTING TEST RESULTS

As received:

Runway Deicing/Anti-icing Chemical Identification:
WINTER WARRIOR RUNWAY CONTROL

Test Temperature: **-10°C (+14°F)**

Time (minute)	Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mass of Ice Melted M_{im} (g)	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	5.00	2.91	5.0	3.0	0.6
	5.00	2.92			
	5.00	3.19			
10	5.00	5.01	5.0	5.1	1.0
	5.00	4.95			
	5.00	5.20			
30	5.00	9.77	5.0	9.0	1.8
	5.00	8.04			
	5.00	9.17			

As received:

Runway Deicing/Anti-icing Chemical Identification:
WINTER WARRIOR RUNWAY CONTROL

Test Temperature: **-2°C (+28°F)**

Time (minute)	Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mass of Ice Melted M_{im} (g)	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	5.00	2.46	5.0	2.7	0.5
	5.00	2.85			
	5.00	2.65			
10	5.00	3.43	5.0	3.3	0.7
	5.00	3.11			
	5.00	3.46			
30	5.00	3.72	5.0	4.0	0.8
	5.00	4.06			
	5.00	4.33			

Table 1 – ICE MELTING TEST RESULTS (continued)

25% w/w

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**					
Test Temperature: **-10°C (+14°F)**					
Time (minute)	Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mass of Ice Melted M_{im} (g)	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	5.00	0.73	5.0	0.7	0.1
	5.00	0.86			
	5.00	0.58			
10	5.00	0.84	5.0	0.9	0.2
	5.00	1.04			
	5.00	0.69			
30	5.00	0.88	5.0	0.9	0.2
	5.00	0.96			
	5.00	0.87			

25% w/w:

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**					
Test Temperature: **-2°C (+28°F)**					
Time (minute)	Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mass of Ice Melted M_{im} (g)	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	5.00	0.59	5.0	0.8	0.2
	5.00	1.20			
	5.00	0.74			
10	5.00	1.76	5.0	1.9	0.4
	5.00	1.84			
	5.00	2.12			
30	5.00	5.03	5.0	4.4	0.9
	5.00	4.00			
	5.00	4.28			

Table 1 – ICE MELTING TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification:
REFERENCE: POTASSIUM ACETATE, 50% w/w solution

Test Temperature: **-10°C (+14°F)**

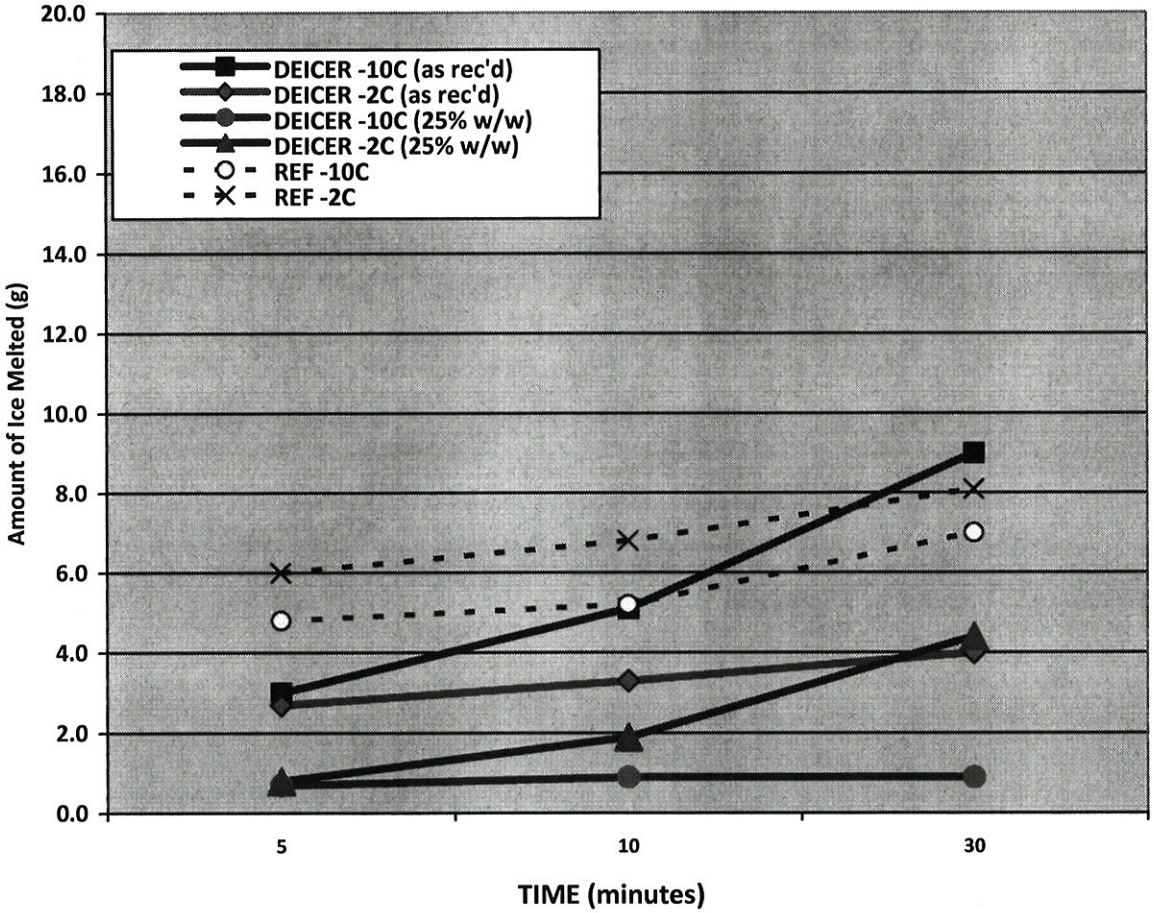
Time (minute)	Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mass of Ice Melted M_{im} (g)	Mean Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mean Mass of Ice Melted M_{im} (g)	Ice Melting Capacity* (m_{im}/m_d)
5	5.00	4.9	5.0	4.8	1.0
	5.00	4.7			
	5.00	4.8			
10	5.00	5.2	5.0	5.2	1.0
	5.00	5.3			
	5.00	5.2			
30	5.00	7.3	5.0	7.0	1.4
	5.00	6.8			
	5.00	6.9			

Runway Deicing/Anti-icing Chemical Identification:
REFERENCE: POTASSIUM ACETATE, 50% w/w solution

Test Temperature: **-2°C (+28°F)**

Time (minute)	Mass of Deicing/Anti-icing Chemical applied m_d (g)	Mass of Ice Melted M_{im} (g)	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	5.00	5.8	5.0	6.0	1.2
	5.00	6.1			
	5.00	6.1			
10	5.00	7.7	5.0	6.8	1.4
	5.00	6.1			
	5.00	6.7			
30	5.00	9.2	5.0	8.1	1.6
	5.00	7.8			
	5.00	7.4			

ICE MELTING RESULTS



Respectfully Submitted,

Patricia D. Viani, SMI Inc.

SMI, Inc.

12219 SW 131 Avenue
Miami, Florida 33186-6401 USA

Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Dominic Steffen
Xynyth Manufacturing Corp
122-3989 Henning Drive
Burnaby BC Canada

Date: 15-Jan-2014

SMI REF: 1308-932$_{R2}$

Product: **WINTER WARRIOR RUNWAY CONTROL** *(received 06-Sep-2013)*

Dilution: 15% w/w

Testing in accordance with
SAE AIR6130
CADMIUM PLATE CYCLIC CORROSION TEST (2012-01)

Cadmium Plate Cyclic Corrosion Test

Initial pH of solution: 10.8 **Final pH of solution**: 9.0

	REPLICATE #	Weight (g)		
		Initial	Final	**Weight change**
PANEL WEIGHTS	1	13.6035	13.5947	**0.0088**
	2	13.5432	13.5350	**0.0082**
	3	13.6077	13.5992	**0.0085**

A runway deicing fluid or solid compound tested in accordance with this document that exhibits a weight loss of more than 0.3 mg/cm^2 (total weight loss more than 0.0077 g for the standard 1 x 2 inch cadmium plated specimen) may cause undesirable corrosion effects to airplane equipment and/or airport equipment.

Average weight change = 0.0085 g per panel (0.30 mg/cm^2)

Result: ***Informational**

see page 5 for complete data tables

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 0.040" (25.40 mm x 50.80 mm x 1.02 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^{0}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

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.

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: **10.8**
pH at end of test: **9.0**

	REPLICATE #	Weight (g)
INITIAL PANEL WEIGHTS	1	13.6035
	2	13.5432
	3	13.6077

	REPLICATE #	Weight (g)		
		Monday	Wednesday	Friday
WEEK #1 PANEL WEIGHTS	1	----	13.5999	13.5988
	2	----	13.5399	13.5389
	3	----	13.6040	13.6029

	REPLICATE #	Weight (g)		
		Monday	Wednesday	Friday
WEEK #2 PANEL WEIGHTS	1	13.5959	13.5952	13.5947
	2	13.5362	13.5356	13.5350
	3	13.5999	13.5996	13.5992

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)
	13.6035	13.5999	13.5988	13.5959	13.5952	13.5947
CUMULATIVE WEIGHT CHANGE ("+" indicates weight gain)	--	0.0036	0.0047	0.0076	0.0083	**0.0088 (FINAL)**

REPLICATE #2	INITIAL WEIGHT	WEEK 1 WED	WEEK 1 FRI	WEEK 2 MON	WEEK 2 WED	WEEK 2 FRI (FINAL WEIGHT)
	13.5432	13.5399	13.5389	13.5362	13.5356	13.5350
CUMULATIVE WEIGHT CHANGE ("+" indicates weight gain)	--	0.0033	0.0043	0.0070	0.0076	**0.0082 (FINAL)**

REPLICATE #3	INITIAL WEIGHT	WEEK 1 WED	WEEK 1 FRI	WEEK 2 MON	WEEK 2 WED	WEEK 2 FRI (FINAL WEIGHT)
	13.6077	13.6040	13.6029	13.5999	13.5996	13.5992
CUMULATIVE WEIGHT CHANGE ("+" indicates weight gain)	--	0.0037	0.0048	0.0078	0.0081	**0.0085 (FINAL)**

SUMMARY:

	REPLICATE #	Weight Change (g)	Average Weight Change	
WEIGHT CHANGE	1	**0.0088**	**0.0085 g (0.30mg/cm^2)**	***Informational**
	2	**0.0082**		
	3	**0.0085**		

"A runway deicing fluid or solid compound tested in accordance with this document that exhibits a weight loss of more than 0.3 mg/cm^2 (total weight loss more than 0.0077 g for the standard 1 x 2 inch cadmium plated specimen) may cause undesirable corrosion effects to airplane equipment and/or airport equipment."

Respectfully Submitted,

Patricia D. Viani, SMI Inc.

SMI, Inc.
12219 SW 131 Avenue
Miami, Florida 33186-6401 USA
Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Dominic Steffen
Xynyth Manufacturing Corp
122-3989 Henning Drive
Burnaby BC Canada

Date: 15-Jan-2014

SMI REF: 1308-932$_{R2}$

Product: **WINTER WARRIOR RUNWAY CONTROL** *(received 06-Sep-2013)*

Dilution: 25% w/w

Testing in accordance with
SAE AIR6211
Ice Penetration Test Method for Runways and Taxiways Deicing/Anti-icing Chemicals (2012-04)

3. SUMMARY OF TEST METHOD

3.1 The test utilizes a Plexiglas® test plate having 5 mm (0.20 in) diameter cavities filled with ice. After equilibration to the desired temperature, a known volume of dyed-liquid runway deicing/anti-icing chemical is discharged onto the surface of ice cones and penetration commences (see Figure 1). Penetration is evidenced by an embedded scale in millimeters behind the Plexiglas® test plate. At specified time intervals, the length of penetration is measured. Testing temperatures shall be within 1^{0}C (2^{0}F) of the stated values and tests shall be performed within a freezer or cold chamber.

3.2 Significance and Use

This test method can be used to evaluate and compare the ice penetrating capabilities of runway deicing/anti-icing chemicals in liquid or solid form over a limited, defined time interval at specified temperatures.

...

3.7 Data Recording and Reporting

Penetration depths, in millimeters, shall be recorded at the test temperature for the time intervals of 5, 10 and 30 min and reported, for example see Table 1. All data is measured in millimeter (mm) and rounded to the nearest 0.5 mm. The recorded value for each temperature/time observation shall be the average of the four cavity depths. Present the graph of the ice penetration as a function of time.

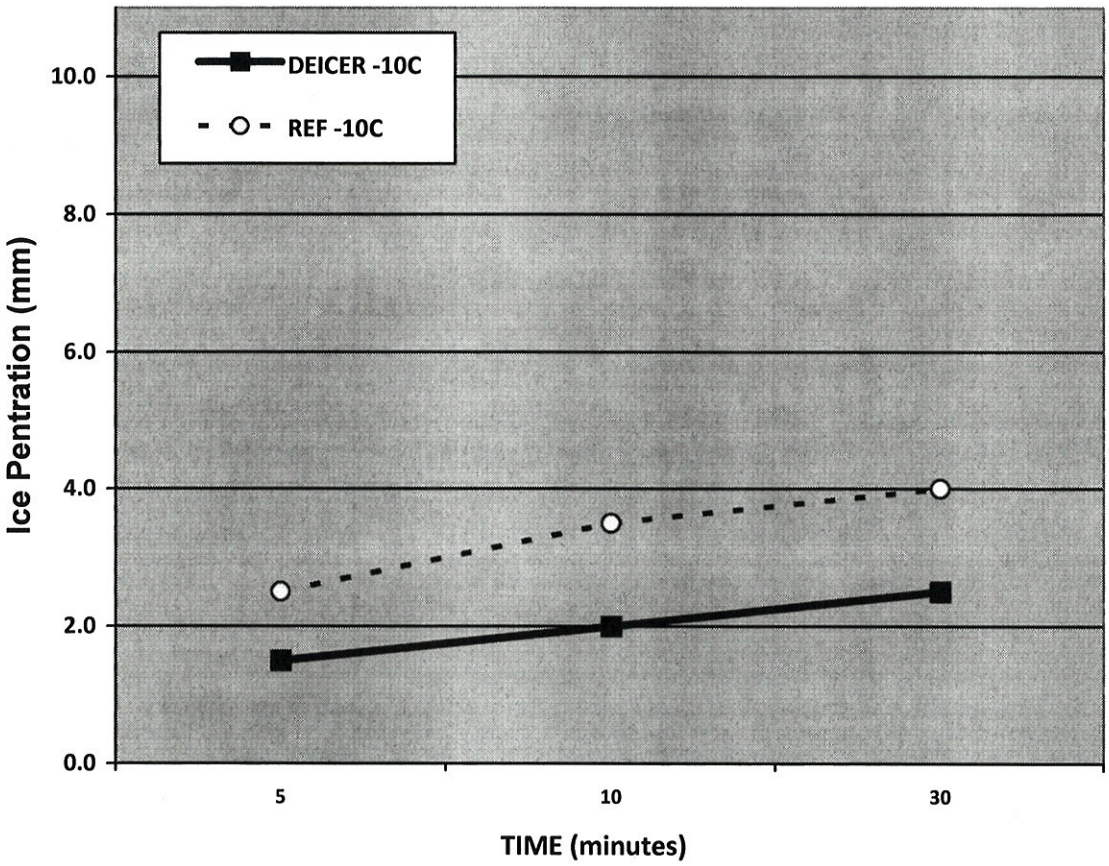
Table 1 – ICE PENETRATION TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**					
Test Temperature **-10^{0}C (+14^{0}F)**:					
Time (minutes)	Penetration Depth (mm)				
	Cavity #1	Cavity #2	Cavity #3	Cavity #4	Average
5	2.0 mm	1.5 mm	1.5 mm	1.0 mm	**1.5 mm**
10	2.5 mm	1.5 mm	2.0 mm	1.5 mm	**2.0 mm**
30	2.5 mm	2.0 mm	2.5 mm	2.5 mm	**2.5 mm**

Runway Deicing/Anti-icing Chemical Identification: **REFERENCE: POTASSIUM ACETATE, 50% w/w solution**					
Test Temperature : **-10^{0}C (+14^{0}F)**					
Time (minutes)	Penetration Depth (mm)				
	Cavity #1	Cavity #2	Cavity #3	Cavity #4	Average
5	2.5 mm	2.5 mm	2.0 mm	2.0 mm	**2.5 mm**
10	3.5 mm	3.5 mm	3.0 mm	3.0 mm	**3.5 mm**
30	4.0 mm	4.0 mm	3.5 mm	4.0 mm	**4.0 mm**

(ALL DATE ROUNDED TO THE NEAREST 0.5 mm)

ICE PENETRATION TEST RESULTS AT -10C



Respectfully Submitted,

Patricia D. Viani, SMI Inc.

SMI, Inc.
12219 SW 131 Avenue
Miami, Florida 33186-6401 USA
Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Dominic Steffen
Xynyth Manufacturing Corp
122-3989 Henning Drive
Burnaby BC Canada

Date: 15-Jan-2014

SMI REF: 1308-932$_{R2}$

Product: **WINTER WARRIOR RUNWAY CONTROL** *(received 06-Sep-2013)*

Dilution: 25% w/w

Testing in accordance with

SAE AIR6172

Ice Undercutting Test Method for Runways and Taxiways Deicing/Anti-icing Chemicals (2012-02)

3. SUMMARY OF TEST METHOD

3.1 Introduction

The test utilizes small cylindrical cavities in a sheet of ice of uniform thickness frozen in a flat circular modified polystyrene Petri dish having an average standardized surface roughness of 120 grit (see Figure 1). The bottoms of the cavities are essentially free of ice. After equilibration to the desired temperature, a known volume of dyed deicing chemical is placed in the cavities, and undercutting commences (see figure 1). Undercutting is evidenced by the formation of essentially circular undercut patterns. At specified time intervals, the dimensions of the observed undercut patterns are measured. The undercut pattern reflects the net result of melting on the walls of the ice cavity and melting at the ice/substrate interface. The undercut is relatively thick near the center and relatively thin at the extremities. The undercut area is defined as the total area of the circular undercut pattern minus the area of the original cavity. Testing temperatures shall be within 1^0C (2^0F) of the stated values and tests shall be performed within a freezer or cold chamber.

3.2 Significance and Use

This test method provides a means to evaluate and compare the rate of ice undercutting capabilities of runway deicing/anti-icing chemicals in liquid or solid form at the ice/substrate interface over limited, defined time intervals at specified temperatures.

3.7 Data Recording and Reporting

Circular-shaped ice undercuttings, in millimeters, shall be recorded for each temperature for the time intervals of 5, 10 and 30 minutes and reported, for example see Table 1 (data for additional time intervals can be gathered upon request). All data is measured in millimeters (mm) within 0.1 mm. The recorded value for each temperature/time observation shall be the average of the five cavities where the measurement of each cavity is the two longest perpendicular axial dimensions (vertical and horizontal). The undercut area is defined as the total area of the circular undercut pattern minus the area of the original cavity. The ice undercutting is calculated according to equations (2)(3) and (4). Present the graph of the ice undercutting area $(mm)^2$ as a function of time.

The ice undercutting area for a given deicer is defined as: $IU=IU_e-A_s$
Where:
IU : Ice undercutting area for a given deicer (mm^2)
IU_e : Total area of circular undercut pattern at specified time interval (mm^2)
A_s : Initial area of original cavity (mm^2)

Table 1 – ICE UNDERCUTTING TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**				Test Temperature: **-10°C (+14°F)**		
Time (minute)	Cavity #	Undercut Cavity Diameter (mm)	Mean Undercut Cavity Diameter (mm)	Total Area IU_{e_2} (mm^2)	Area Original Cavity A_s (mm^2)	Ice Undercutting IU (mm^2)
5	1	8.6	9.4	69.4	7.1	62.3
	2	9.2				
	3	10.5				
	4	10.0				
	5	8.5				
10	1	8.7	9.5	70.9	7.1	63.8
	2	9.5				
	3	10.6				
	4	10.1				
	5	8.7				
30	1	8.8	9.4	69.4	7.1	62.3
	2	9.6				
	3	11.0				
	4	8.8				
	5	8.9				

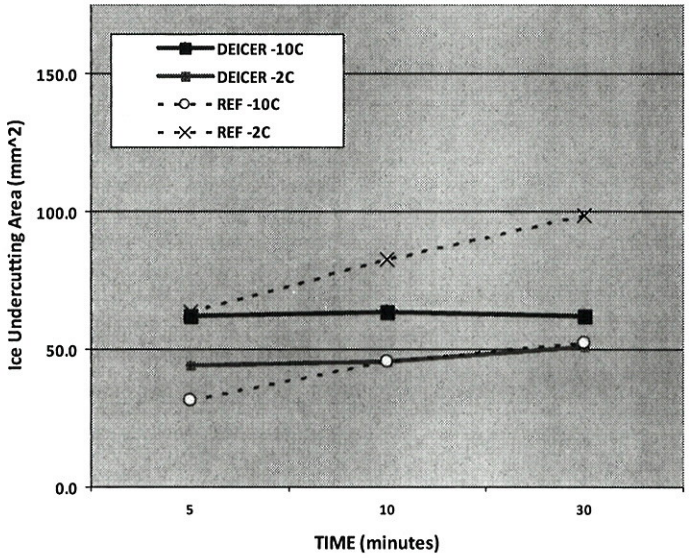
Runway Deicing/Anti-icing Chemical Identification: **WINTER WARRIOR RUNWAY CONTROL**				Test Temperature: **-2°C (+28°F)**		
Time (minute)	Cavity #	Undercut Cavity Diameter (mm)	Mean Undercut Cavity Diameter (mm)	Total Area IU_{e_2} (mm^2)	Area Original Cavity A_s (mm^2)	Ice Undercutting IU (mm^2)
5	1	8.5	8.1	51.5	7.1	44.4
	2	7.8				
	3	7.5				
	4	8.1				
	5	8.4				
10	1	8.6	8.2	52.8	7.1	45.7
	2	7.9				
	3	7.7				
	4	8.3				
	5	8.5				
30	1	8.9	8.6	58.1	7.1	51.0
	2	8.2				
	3	8.6				
	4	8.5				
	5	8.7				

Table 1 – ICE UNDERCUTTING TEST RESULTS

Runway Deicing/Anti-icing Chemical Identification: **REFERENCE: POTASSIUM ACETATE, 50% w/w solution**				Test Temperature: **-10°C (+14°F)**		
Time (minute)	Cavity #	Undercut Cavity Diameter (mm)	Mean Undercut Cavity Diameter (mm)	Total Area IU_e (mm^2)	Area Original Cavity A_s (mm^2)	Ice Undercutting IU (mm^2)
5	1	6.3	7.0	38.4	7.1	31.4
	2	6.7				
	3	7.1				
	4	7.4				
	5	7.5				
10	1	7.6	8.2	52.7	7.1	45.6
	2	7.9				
	3	8.5				
	4	8.5				
	5	8.5				
30	1	8.0	8.7	59.4	7.1	52.3
	2	8.8				
	3	8.8				
	4	8.9				
	5	9.0				

Runway Deicing/Anti-icing Chemical Identification: **REFERENCE: POTASSIUM ACETATE, 50% w/w solution**				Test Temperature: **-2°C (+28°F)**		
Time (minute)	Cavity #	Undercut Cavity Diameter (mm)	Mean Undercut Cavity Diameter (mm)	Total Area IU_e (mm^2)	Area Original Cavity A_s (mm^2)	Ice Undercutting IU (mm^2)
5	1	9.1	9.5	70.8	7.1	63.7
	2	9.2				
	3	9.9				
	4	9.7				
	5	9.6				
10	1	10.6	10.7	89.9	7.1	82.8
	2	10.3				
	3	10.9				
	4	10.8				
	5	10.9				
30	1	11.4	11.6	105.6	7.1	98.5
	2	11.5				
	3	11.3				
	4	11.9				
	5	11.9				

ICE UNDERCUTTING RESULTS



Respectfully Submitted,

Patricia D. Viani, SMI Inc.