METSS CORPORATION

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METSS ADF-2

Aircraft Deicing Fluid

....the most environmentally friendly ADF on the market.

Technical Data Sheet

300 Westdale Avenue • Westerville, OH 43082 • p. 614.797.2200 • f. 614.797.2201

DESCRIPTION - METSS ADF-2

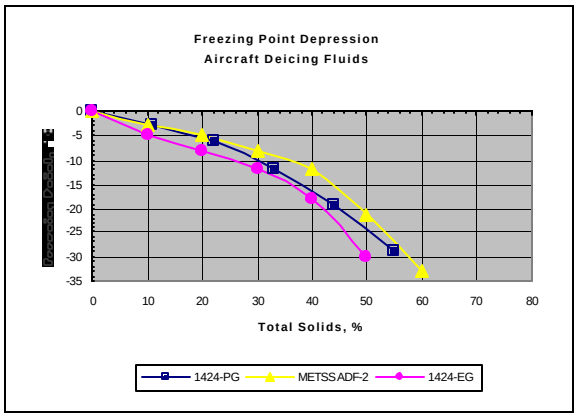
METSS ADF-2 represents a new class of environmentally friendly ice control agents designed for aircraft use. The unique features and benefits of METSS ADF-2 make it an ideal alternative to the traditional ethylene and propylene glycol based fluids for those applications in which environmental issues are a concern.

METSS ADF-2 is composed primarily of food-grade materials derived from the processing of starches and sugars. As such, this abundant and renewable agricultural feedstock is both economical and readily available. Unlike ethylene glycol-based fluids, METSS ADF-2 is nontoxic and non-hazardous to plant and animal life. It contains no phosphates or urea that tend to promote eutrophication of natural waterways that may subsequently lead to fish-kills. METSS ADF-2 biodegrades readily and completely to carbon dioxide and water.

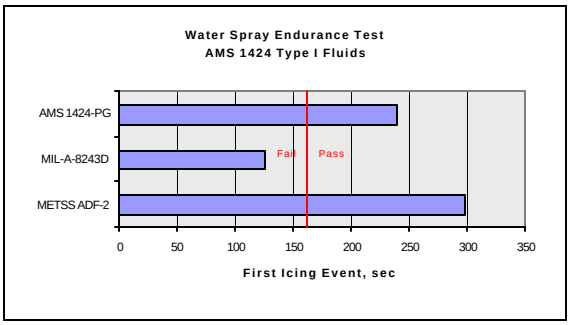
Compared to propylene glycol, METSS ADF-2 has a lower Biological Oxygen Demand (BOD) and biodegrades at a slower rate. Commercial airports and military bases are increasingly concerned about the quality of storm water runoff and the effect of deicing chemicals on receiving waters. If storm water drains directly from runways and taxiways into a body of water, discharge permits require regular monitoring of runoff to determine several properties including BOD and contaminants. Due to its low BOD, the use of METSS ADF-2 can assist airport managers in achieving environmental compliance.

METSS ADF-2 may used both as a deicing agent to melt ice deposits and aid in their removal, and as an anti-icing agent to prevent the frozen precipitation from accumulating on aircraft wing surfaces. METSS ADF-2 meets all requirements of the SAE AMS 1424D for aircraft deicing fluids.

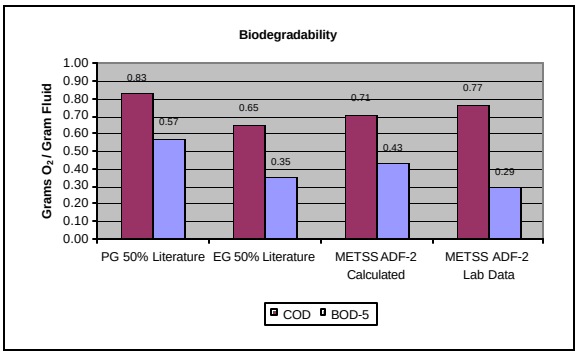
PERFORMANCE DATA



In order to be truly effective, an anti-icing/deicing fluid must not only exhibit a low freezing point, it must have the capacity to absorb large amounts of water from melting ice and continue to function at high dilution. METSS ADF-2 provides both of these important attributes, having a freezing point of -31°C and high dilution capacity. Its freezing point depression properties closely match those of conventional ethylene and propylene glycol Type I deicing fluids.



Anti-icing performance is not only a function of freezing point but metal wetting characteristics, surface tension, film thickness and adhesion as well. The Water Spray Endurance Test measures the anti-icing performance of the fluid on a coated aluminum surface when exposed to water spray at –5°C. The film-forming characteristics of METSS ADF-2 provide excellent anti-icing performance when compared with conventional glycol fluids.



METSS ADF-2 was developed to address the issues of the high BOD associated with propylene glycol and the toxicity of ethylene glycol. METSS ADF-2 has been specifically formulated to closely mimic the biodegradation rate of ethylene glycol while retaining the non-toxic characteristics of propylene glycol. Based on BOD values calculated from those reported for its components, METSS ADF-2 is expected to show a 25% reduction in BOD versus 50% PG. Actual lab tests on the fluid exhibit a 49% reduction in BOD versus 50% PG. This reduction in the BOD contribution of the fluid represents a significant savings to airport waste treatment facilities.

A unique non-triazole corrosion inhibitor package provides multi-metal protection while exhibiting very low aquatic toxicity. Independent lab data verifies that METSS ADF-2 is the least toxic deicing fluid on the market today.

TYPICAL PROPERTIES

Appearance	Clear Orange Liquid
Odor	Mild, Characteristic
Specific Gravity	1.205
Pounds Per Gallon	10.04
Flash Point, COC	None
Freezing Point	-27°F(-33°C)
Biological Oxygen Demand (5-Day), g/g	0.29
Chemical Oxygen Demand, g/g	0.77
Aquatic Toxicity, mg/L	
Daphnia magna, 48 hr LC_{50}	14,375
Pimephales promelas, 96 hr LC_{50}	12,275

Aircraft Anti-Icing/Deicing Fluid, Type I
Requirements and Data Summary

SAE AMS 1424D Technical Requirements	Section Number	Test Requirement	METSS ADF-2 Test Results
Fluid Type		NA	Non-Glycol
Concentrate or Ready -to-Use		NA	Ready To Use
Non-Glycol Fluids	3.1.1		
Hot Corrosion vs. DI Water Control		Pass/Fail	Conforms
Appearance	3.1.2	Clear	Conforms
Color	3.1.2	Orange	Conforms
Environmental Information	3.1.4	Informational	Informational
BOD_5 @ 20C	3.1.4.1	Report	0.29
TOD or COD	3.1.4.2	Report	0.81
Biodegradability @ 5 days	3.1.4.3	Report	38%
Daphnid Acute Toxicity, LC50	3.1.4.4	> 4000 mg/L	14,375 mg/L
Fish Acute Toxicity, LC50	3.1.4.4	> 4000 mg/L	12,275 mg/L
Trace Contaminants	3.1.5	Informational	Informational
Sulfur		Report	< 1 ppm
Halogens		Report	<10 ppm
Phosphate		Report	< 1 ppm
Nitrate		Report	< 2 ppm
Lead		Report	< 1 ppm
Chromium		Report	< 1 ppm
Cadmium		Report	< 1 ppm
Mercury		Report	< 1 ppm
Physical Properties	3.2		
Flash Point	3.2.1	> 100C	Conforms
Specific Gravity	3.2.2	Report	1.204
pH	3.2.3	Report	8.6
Refractive Index	3.2.4	Report	1.4254
Freezing Point	3.2.5	< -20C	-33C
Surface Tension	3.2.6	Report	35.9 dynes/cm
Viscosity, centipoises	3.2.7	Report	Informational
@ 20C			21
@ 0C			53
@ -10C			104
@ -20C			225
Fluid Stability	3.3		
Storage Stability	3.3.1	Pass/Fail	In Progress
Thermal Stability, pH Change	3.3.2	< 0.5	0.1
Hard Water Stability	3.3.3	Pass/Fail	Not Applicable
Shear Stability	3.3.4	Pass/Fail	Not Applicable
Sandwich Corrosion	3.4.1	Corrosion Rating	Conforms
2024 T-3 Bare Anodized		1	1
2024 T-3 Alclad		1	1
7075 T-6 Bare Anodized		1	1
7075 T-6 Alclad		1	1
Total Immersion Corrosion	3.4.2	Wt Change ($mg/cm^2/24h$)	Conforms
AMS 4037 Al Alloy, Anodized		<0.3	<0.01
AMS 4041 Al Alloy, Alclad		<0.3	0.02
AMS 4049 Al Alloy, Alclad		<0.3	0.01
AMS 4376 Mg Alloy, Dichromated		<0.2	0.05
AMS 4911 Ti Alloy		<0.1	<0.01
AMS 5045 Carbon Steel		<0.8	+0.01
Low Embrittling Cadmium Plate	3.4.3	<0.3	0.02
Stress Corrosion, AMS 4911	3.4.4	Pass/Fail	Conforms
Stress Corrosion, AMS 4916	3.4.4	Pass/Fail	Conforms
Hydrogen Embrittlement	3.4.5	Pass/Fail	Conforms
Effect on Acrylic Plastics	3.4.6.1	Pass/Fail	Conforms
Effect on Polycarbonate Plastics	3.4.6.2	Pass/Fail	Conforms
Effect on Painted Surfaces	3.4.7	Pass/Fail	Conforms
Effect on Unpainted Surfaces	3.4.8	Pass/Fail	Conforms
Concrete Scaling Resistance	3.4.9	1	1
Performance Properties	3.5		
Freezing Point	3.5.1.1	< -20C	-31C - Conforms
Anti-Icing Performance	3.5.2		
WSET		> 3 minutes	5.00 - Conforms
HHET		> 20 minutes	35:00 - Conforms
Aerodynamic Acceptance	3.5.3		
@ 0C		Pass/Fail	Conforms
@ -10C		Pass/Fail	Conforms
@ -20C		Pass/Fail	Conforms
@ -23C		Pass/Fail	Conforms

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METSS RDF-1

Runway Deicing Fluid

....the best RDF on the market.

Technical Data Sheet

300 Westdale Avenue • Westerville, OH 43082 • p. 614.797.2200 • f. 614.797.2201

DESCRIPTION - METSS RDF-1

METSS RDF-1 represents a significant improvement on potassium acetate deicing fluids designed for airport runway applications. The unique features and benefits of METSS RDF-1 make it an ideal alternative to conventional potassium acetate fluids for applications requiring a high-performance, environmentally-friendly and low-corrosion deicing fluid. METSS RDF-1 meets all FAA requirements of the SAE AMS 1435A specification for runway deicing fluids and is manufactured in a quality-controlled environment to ensure that product features and performance characteristics are consistently of the highest quality.

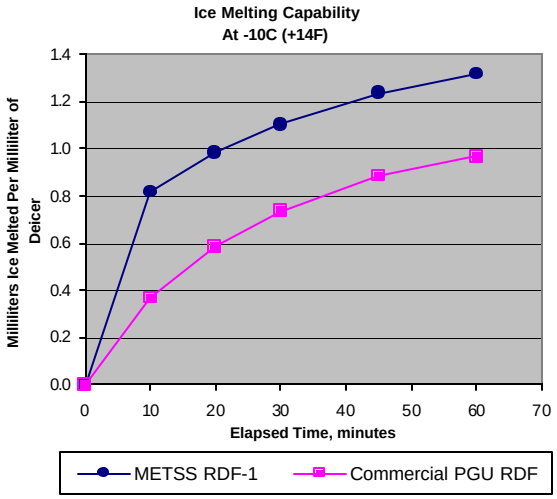
Improved Corrosion Inhibition. A unique multi-metal corrosion inhibitor package developed especially for use in KAc based fluids provides exceptional corrosion protection on all common aircraft metals, including magnesium and cadmium. Improved cadmium corrosion protection is of recent interest for KAc based products.[1] In addition, the METSS RDF-1 fluid also provides improved corrosion protection on other important metals not addressed by the AMS 1435A specification. Laboratory tests indicate that METSS RDF-1 can substantially reduce corrosion of galvanized steel and copper. Compatibility with these metals is critical for airport runway operations, as the in-ground lighting fixtures used by most major airports are constructed from galvanized steel, and copper wiring is used in electrical connections.

Improved Wetting and Spreading. An added benefit of the METSS RDF-1 additive package is that the wetting characteristics of the KAc base fluid are significantly enhanced, providing improved spreading and coverage. Additionally, these properties enhance the fluid film adhesion characteristics such that the fluid sticks to the surface and lasts longer between applications.

Rapid Drying Time. METSS RDF-1 exhibits rapid drying characteristics after application, making treated runways available for use in less time. Runway availability is obviously an important issue at high traffic airports.

Environmentally Friendly. METSS RDF-1 is nontoxic and non-hazardous to plant and animal life; in the environment, it biodegrades readily and completely to carbon dioxide and water. It has a very low Biological Oxygen Demand (BOD) and contains no phosphates or urea that tend to promote eutrophication of natural waterways that may subsequently lead to fish-kills.

High Performance. In ice melting tests conducted according to the SHRP H-205.2 method, the performance of METSS RDF-1 potassium acetate fluid is significantly better than propylene glycol/urea (PGU) fluids used for runway deicing.



TYPICAL PROPERTIES

Appearance	Clear Blue Liquid
Odor	Mild, Characteristic
Specific Gravity	1.282
Pounds Per Gallon	10.7
Flash Point, COC	None
Water Miscibility	Complete
Freezing Point	-76°F(-60°C)
BOD (5-Day), g/g	0.25
TOD, g/g	0.35

APPLICATION

METSS RDF-1 is supplied in a ready to use liquid form, making its application by spray trucks convenient and easy. Suggested rates of application are as follows:

Anti-icing: The most efficient use of METSS RDF-1 is pre-treatment application prior to the start of an icing event at the rate of 0.5 gallons per 1000 ft^2.

Deicing: METSS RDF-1 is an effective deicer when allowed to penetrate to the pavement surface to break the bond of ice and snow. While the amount of fluid required depends on outside temperature as well as the thickness of the ice film an application of 1.0 gallon per 1000 ft^2 is recommended for thin ice and 3.0 gallons per 1000 ft^2 for ice up to an inch thick.

HANDLING AND STORAGE

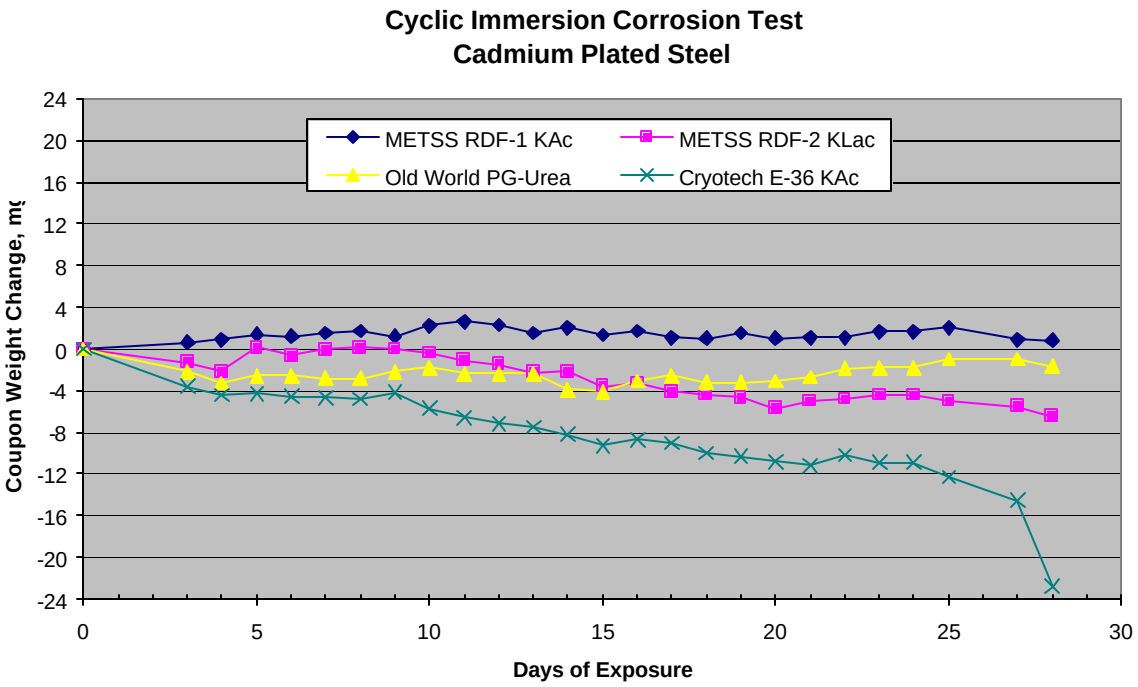
Refer to material safety data sheet for any details of handling and disposal of waste or spills. Keep containers closed when not in use.

[1] Because of cadmium concerns, Boeing has issued advisories concerning 737 operations in which they specify that planes exposed to potassium acetate are to be taken off-line and washed.

LIQUID AIRPORT RUNWAY DEICING FLUIDS
REQUIREMENTS AND DATA SUMMARY

SAE AMS 1435A Technical Requirements	Section Number	Test Requirement	METSS RDF-1 KAc Fluid
Fluid Type		NA	KAc
Appearance	3.1.2	Clear	Clear
Color (If Dyed)	3.1.2	Blue	Blue
Environmental Information	3.1.1		
BOD_5 @ 20°C	3.1.1.1	Report	0.25 kg/kg
TOD @ 20°C	3.1.1.1	Report	0.35 kg/kg
Daphnia Acute Toxicity, LC50	3.1.1.2	Report	1280 mg/L
Fish Acute Toxicity, LC50	3.1.1.2	Report	2150 mg/L
Trace Contaminants	3.1.1.3		
Sulfur		Report	3 ppm
Halogens		Report	22 ppm
Phosphate		Report	< 1 ppm
Nitrate		Report	< 1 ppm
Lead		Report	< 1 ppm
Chromium		Report	< 1 ppm
Cadmium		Report	< 1 ppm
Mercury		Report	< 1 ppm
Physical Properties	3.2		
Flash Point	3.2.1	> 100°C	Pass
Specific Gravity	3.2.2	Report	1.282
Conductivity, millimhos	NA	Not Established	520
Fluid pH	3.2.3	7.5 – 11.5	10.5
Freezing Point, as supplied	3.2.4	Not Reported	-60°C
Freezing Point, 1:1 dilution	3.2.4	< -14.5°C	-17°C
Sandwich Corrosion	3.2.5.1		
2024 T-3 Bare Anodized		1	1
2024 T-3 Alclad		1	1
7075 T-6 Bare Anodized		1	1
7075 T-6 Alclad		1	1
Total Immersion Corrosion Rate	3.2.5.2	$mg/cm^2/24h$	
AMS 4037 Al Anodized		< 0.3	< 0.01
AMS 4041 Al Alloy		< 0.3	< 0.01
AMS 4049 Al Alloy		< 0.3	< 0.01
AMS 4376 Mg, Dichromated		< 0.2	0.08
AMS 4911 Ti Alloy		< 0.1	< 0.01
AMS 5045 Carbon Steel		< 0.8	0.02
Galvanized Steel		Not Established	0.05
Copper		Not Established	< 0.01
Low Embrittling Cadmium Plate	3.2.5.3	< 0.3	< 0.01
Hydrogen Embrittlement	3.2.5.4	Pass/Fail	Pass
Stress Corrosion, AMS 4911	3.2.5.5	Pass/Fail	Pass
Stress Corrosion, AMS 4916	3.2.5.5	Pass/Fail	Pass
Effect on Acrylic Plastics	3.2.6	Pass/Fail	Pass
Effect on Polycarbonate Plastics	3.2.6	Pass/Fail	Pass
Effect on Painted Surfaces	3.2.7	Pass/Fail	Pass
Effect on Unpainted Surfaces	3.2.8	Pass/Fail	Pass
Rinsibility	3.2.9	Pass/Fail	Pass
Concrete Scaling Resistance	3.2.10	< 1	Pass
Storage Stability	3.2.11	Pass/Fail	In Process
Polarization Resistance Corrosion Rate (4 day exposure), mils per year	NA		
Galvanized Steel		0.85	0.597
Carbon Steel		Not Established	0.0009
Aluminum 6061 Alloy		Not Established	0.0180
Wetting Characteristics	NA	Not Established	Better than Commercial KAc Fluid
Drying Time	NA	Not Established	Better than Commercial PGU Fluid

METSS RDF-1 Provides Superior Cadmium Corrosion Protection



Test Specimens:

4130 Steel, Cadmium plated (Low Hydrogen Embrittlement) per ASTM F1111, size 1” X 2”

Test Procedure:

1. Measure and record pH of solution(s) to be tested.

2. Prepare and test the cadmium plated specimens in accordance with ASTM F1111, except extend the immersion time to 72 hours (instead of 24 hours). Begin the test on a Friday.

3. After immersion, remove specimens without rinsing and place them in small glass or non-reactive plastic containers so that they rest upright at an approximate 45 degree angle. Specimens shall be maintained at room temperature (72 + 5F) and relative humidity (40 + 10%). Maintain the specimens in this condition for 23 hours. This step shall be referred to as the environmental exposure.

4. Rinse specimens with water. Specimens shall be lightly brushed with a soft nylon brush while rinsing. Dry specimens thoroughly by rinsing with a stream of acetone from a wash bottle. Shake free from acetone and dry in a 110oC oven for 1 h and allow to cool to room temperature in a desiccator.

5. Weigh and record specimen weight.

6. Return specimens to solution to soak for 1 hour each weekday.

7. Repeat steps 3 through 6. Maintain specimens in initial orientation.

8. Repeat cycles for 30 days. Report weight changes for each specimen at each time interval. If average weight change exceeds 8.5 mg per 1" x 2" panel (0.3 mg/cm2), testing may be halted.