

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

RATIONALE

This test method, for liquid and solid deicing/anti-icing chemicals, offers a quantitative procedure to evaluate the amount of ice melted as a function of the time and temperature by such deicing/anti-icing chemicals and is based on the SHRP H-205.2- MODIFIED FOR AIRPORT APPLICATION (draft April 17/02) - Test Method for Ice Melting of Liquid Deicing Chemicals (or Solids).

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1. SCOPE

This test method provides stakeholders (runway deicing chemical manufacturers, deicing/anti-icing chemical operators and airport authorities) with relative ice melting capacity of runway deicing chemicals, by measuring the amount of ice melted as a function of time. Such runway deicing chemicals are often also used on taxiways.

This test method does not quantitatively measure the theoretical or extended time ice melting capability of ready-to-use runway deicing/anti-icing chemicals in liquid or solid form.

1.1 Minimum Requirements

This method sets the minimum requirements for the determination of ice melting capabilities of SAE AMS 1431 and 1435 runway deicing/anti-icing chemicals in liquid and solid form as a function of time and temperature under controlled laboratory conditions.

1.2 Hazardous Materials

This test may involve the use of hazardous materials, operations, and equipment. This standard does not address the safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.3 Standard Units

The values stated in SI units are to be regarded as the standard.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS1431 Compound, Solid Runway and Taxiway Deicing/Anti-icing

AMS1435 Fluid, Generic, Deicing/Anti-icing, Runways and Taxiways

2.2 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 D 1193 Specification for Reagent Water

ASTM D 1747 Refractive Index of Viscous Materials

2.3 ISO Publications

Available from International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, Tel: +41-22-749-01-11, www.iso.org.

ISO 9001-2008 Quality Management Systems – Requirements

2.4 Other Reference Documents

Handbook of Test Methods for Evaluating Chemical Deicers, Strategic Highway Research Program, National Research Council Washington, DC 1992, SHRP-H-332

3. SUMMARY OF TEST METHOD

3.1 Introduction

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 (see FIGURE). At specified time intervals, generated brines are removed and the mass difference is calculated in order to obtain the mass of melted ice. Testing temperatures shall be within 1 °C (2 °F) of the stated values and tests shall be performed within a freezer or a cold chamber.



FIGURE 1 - EXAMPLE OF ICE MELTING SET-UP

3.2 Significance and Use

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.

3.3 Test Equipment and Materials

The following test procedure may be performed on deicing/anti-icing chemicals in liquid or solid form.

3.3.1 Material

- Polystyrene petri dish, 150 mm (6 in) diameter & 15 mm (0.6 in) deep (or equivalent). e.g.; BD Falcon disposable petri dishes, sterile, Fisher Scientific cat. # 08-757-148.
- Refrigerator or cold room to store the material at 4 °C ± 1 °C (39 °F ± 2 °F)
- Compressed air gun
- Graduated cylinder
- Digital thermometer (or equivalent)

- f. Digital timer (or equivalent)
- g. Reagent water ASTM D1193, Type IV (or equivalent)
- h. Plastic syringe (without needle) with a capacity of 5 mL to 10 mL
- i. Disposable polystyrene weighing boat (or equivalent), with a capacity of 5 to 10 g
- j. Balance (precision ± 0.01 g)

3.3.2 Polystyrene Petri Dish

The ice melting test is performed in the petri dish. The ice surface area corresponds to 0.018 m^2 (see Figure 1). The dimensions of the petri dish may be adjusted to accommodate space limitations; however, any changes in the ice surface area may necessitate proportional changes in deicing/anti-icing chemical test sample size and/or volume of water used to grow the ice.

3.3.3 Test Dish Accessories

A thermometer or temperature sensor serves as a means to observe temperature.

3.3.4 Deicing/Anti-icing Chemical Distribution Equipment

3.3.4.1 Liquid Deicing/Anti-icing Chemical

A plastic syringe is used to distribute the liquid deicing/anti-icing chemical.

3.3.4.2 Solid Deicing/Anti-icing Chemical

A disposable plastic weighing boat is used to distribute the solid deicing/anti-icing chemical

3.3.5 Ice Preparation

The petri dishes and material required for the ice preparation (water, graduated cylinder, etc ...) have to be kept at $4 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ ($39 \text{ }^\circ\text{F} \pm 2 \text{ }^\circ\text{F}$) for a minimum period of $8 \text{ h} \pm 1 \text{ h}$ prior to preparing the ice. Sixty milliliters of water correspond to an ice thickness of 3.4 mm in the test dish. This pre-cooled quantity (60 mL) of ASTM D 1193, Type IV water is poured in the petri dish and swirled or stirred to distribute water over the surface. The petri dish is then placed on a level surface in a freezer or cold room at $-10 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ ($14 \text{ }^\circ\text{F} \pm 2 \text{ }^\circ\text{F}$) within 5 min after filling the test dish with water. The uncovered petri dish with the water is kept in the freezer or cold chamber until the water is completely frozen (minimum 8 hours). The ice formation period may be prolonged until the water is completely frozen. During the ice formation, it is recommended to maintain ventilation as low as possible to obtain a smoother ice surface.

3.3.6 Standard Measuring Devices

All temperature sensors, electronic balances, and timing devices shall be maintained in a known state of calibration by means of a Quality Management System recognized by an international standards organization such as ISO 9001-2008 (or equivalent).

3.4 General Test Procedure

The petri dish containing the ice sheet shall be stored at the intended test temperature at least $10 \text{ h} \pm 1 \text{ h}$ prior to the test. It has to be weighed at room temperature. The value is read from a scale after exactly 20 seconds ($= m_s$). After that, the petri dish is immediately returned into the test chamber. The test solution (or solid) is applied on the ice surface as uniformly as possible, according to paragraph 3.5. A digital timer is activated when deicing/anti-icing chemical samples are applied to ice specimens (A plastic knife may be used to discharge high viscosity products, taking no more than 15 seconds to spread the deicing/anti-icing chemical).

After 5 minutes, the test dish is tilted (at approximately 80-85°) and the brines are gently blown away using a compressed air gun for a maximum of 10 seconds (while in the cold chamber at the test temperature). The air pressure must be between 103 KPa (15 psi) and 140 KPa (20 psi). The air must be free of oil and any other impurities. Make sure that only liquid brine is blown away with the compressed air, if ice pieces or ice particles are blown away, the test must be repeated.

When the brines are blown away, bring the petri dish to the scale (make sure that no liquid or solid remain on the outside parts of the dish). Weigh the petri dish at room temperature and read the value from the scale after exactly 20 seconds.

The amount of ice melted is calculated from the initial and final masses of the petri dish according to the Equation 1.

$$m_{im} = m_s - m_e \quad (\text{Eq. 1})$$

where :

- m_{im} ; mass of ice melted (g)
- m_s ; initial mass of petri dish and ice sheet (g)
- m_e ; final mass of petri dish and remaining ice (g)

Repeat the same procedure (using a fresh ice sheet) for time intervals of 10 and 30 minutes and record the results. The ice melting test can be performed at any other time interval upon agreement between purchaser and vendor.

3.5 Deicing/Anti-icing Chemical Application Procedure

The deicing/anti-icing chemical (liquid or solid) is kept at the intended test temperature at least 10 h \pm 1 h prior to the test.

3.5.1 Liquid Runway Deicing/Anti-icing Chemical

The amount of liquid runway deicing/anti-icing chemical applied should correspond to a mass of 5 g. Weigh the empty slip tip plastic syringe and record the mass: any liquid on exterior surfaces is removed by a tissue (with the tip pointing upward, excess liquid and air bubbles are discharged). By the method of mass differences, adjust the volume of liquid deicing/anti-icing chemical corresponding to the mass required for the test (typically 5.00 g \pm 0.01 g). The ice-melting test is initiated by discharging the liquid deicing/anti-icing chemical uniformly onto the ice surface.

3.5.2 Solid Runway Deicing/Anti-icing Chemical

The solid deicing/anti-icing chemical shall be tested in both "as is" and diluted forms, as described in section 3.5.2.1 and 3.5.2.2

3.5.2.1 Solid Deicing/Anti-icing Chemical: Tested as Solid Form "as is"

The required amount of solid deicing/anti-icing chemical should be weighed using a disposable weighing boat (typically 5.00 g \pm 0.01 g). However, an alternative option is to use a small beaker or any other convenient dish. The ice-melting test is initiated by applying the solid uniformly onto the ice surface.

3.5.2.2 Solid Deicing/Anti-icing Chemical: Tested as Diluted Form

The solid runway deicing/anti-icing chemical must be diluted to give a 25% w/w solution. To obtain this 25 % w/w solution, dissolve "x" g of solid runway deicer in "3x" g of demineralized water. The diluted deicing/anti-icing chemical is applied as described in section 3.5.1.