



TECHNICAL SPECIFICATION AIRCRAFT DEICERS

SPECIFICATION

1 General

The objective of the airport authorities is that the de-/anti-icing agents used on aircraft shall be optimal with respect to flight safety, environment, working environment and economy. In the present case this requirement specification is one part in the ambition to give the signal to vendors which parameters that are important to fulfil the aim.

The de-/anti-icing agents shall fulfil the requirements set in this specification documented in the list of compliance. Measured test values to be documented with value, date of measurement and laboratory. A complete quality assurance system including transport, storage, storage stability, fluid pumping and handling of containers and traceability shall be presented.

2 AMS Certification

2.1 *Fluids type I*

All requirements in SAE AMS 1424 (latest version) **shall** be fulfilled and presented with test reports. Measured test values, date of test and laboratory should be documented in Appendix A.

2.2 *Fluids type II/IV*

All requirements in SAE AMS 1428 (latest version) **shall** be fulfilled and presented with test reports. Measured test values, date of test and laboratory should be documented in Appendix B.

3 Technical characteristics versus bitumen and asphalt

The de-/anti-icing agents **shall** be tested, documented and verified by the laboratories stated in Appendix C in compliance with the test methods as described in the same appendix. The tests according to Appendix C shall be from 2014 and later.

4 Technical properties

The contractors **shall** document technical properties according to Appendix D.

5 Environmental properties

The contractor **shall** document environmental properties of all de-icing agents and all additives in compliance with Appendix E.

The documentation **shall** be presented in compliance with Appendix E.

6 Working environment

The contractor **shall** document known effects on working environment and health for persons handling the de-/anti-icing agents. Known effects to be documented as shown in Appendix F.

The contractor **shall** clearly and crisply document the equipment needed for those handling the de-/anti-icing agents for exposure control, personal protection and first-aid measures. Equipment needed shall be documented in Appendix F.

7 Appendices

- Appendix A: AMS 1424 – specification fluids type I
- Appendix B: AMS 1428 – specification fluids type II/IV
- Appendix C: Technical characteristics versus bitumen/asphalt concrete pavement
- Appendix D: Technical properties
- Appendix E: Environmental requirement for de-icing chemicals
- Appendix F: Working environment - documentation

Appendix A

AMS 1424 – specification fluids type I.

Product Name: _____

Test Laboratory: _____

Technical Requirements	Ref. Para	Test Method	Publication	Max. / Min. Values	Remarks	Measured Test Result	Date
Material	3.1						
Appearance	3.1.4				Shall be orange		
Environmental information	3.1.5		APHA		Fulfil national and local toxicity requirements		
Trace contaminants	3.1.6				Present used test method		
Flash point	3.2.1	ASTM D 93/3278	ASTM	> 100°C (212 °F)			
Specific gravity	3.2.2	ASTM D 891/4052	ASTM	± 0.015 of the preproduction value			
PH value	3.2.3	ASTM E 70	ASTM	± 0.5 of the preproduction value			
Refractive index	3.2.4	ASTM D 1747	ASTM	± 0.0015 of the preproduction value			
Freezing point	3.2.5	ASTM D 1177	ASTM	± 3°C (5 °F) of the preproduction value			
Surface tension	3.2.6	ASTM D 1331	ASTM	± 10% of the preproduction value at 20°C (68 °F)			
Viscosity	3.2.7	ASTM D 445	ASTM	± 5% of the preproduction value at temp. 20, 0, -10 and -20°C (68, 32, 14 and -4 °F)			
Storage stability	3.3.1	ASTM D 445/1193 ASTM F 1105	ASTM				
Thermal stability	3.3.2	ASTM E 70 ASTM D 1747	ASTM				
Hard water stability	3.3.3						
Shear stability	3.3.4						
Foam stability	3.3.5	AS5901					
Sandwich corrosion	3.4.1	ASTM D 1193 ASTM F 1110	ASTM				
Total immersion corrosion	3.4.2						
Aluminium				max 0,3 mg/cm ² in percentage by weight	Period 24 h		
Magnesium				max 0,2 mg/cm ² in percentage by weight	Period 24 h		

Appendix B

AMS 1428 – specification fluids type II/IV.

Product Name: _____

Test Laboratory: _____

Technical Requirements	Ref. Para	Test Method	Publication	Max. / Min. Values	Remarks	Measured Test Result	Date
Material	3.1						
Toxicity	3.1.4				Fulfil national and local toxicity requirements		
Appearance	3.1.5						
Environmental information	3.1.6		APHA, OECD				
Trace contaminants	3.1.7				Present used test method		
Flash point	3.2.1.1	ASTM D 93/3278	ASTM	> 100°C (212 °F)			
Specific gravity	3.2.1.2	ASTM D 891/4052	ASTM	± 0.015 of the preproduction value			
PH value	3.2.1.3	ASTM E 70	ASTM	± 0.5 of the preproduction value			
Refractive index	3.2.1.4	ASTM D 1747	ASTM	± 0.0015 of the preproduction value			
Surface tension	3.2.1.5	ASTM D 1331	ASTM	± 10% of the preproduction value at 20°C (68 °F)			
Thermal stability-accelerated aging	3.2.2.1						
Exposure to dry air	3.2.2.2						
Dry-out by exposure to cold dry air	3.2.2.3	ASTM D 1193	ASTM				
Successive dryout and rehydration	3.2.2.4	Annex D					
Thin film thermal stability	3.2.2.5	ASTM D 1193	ASTM				
Storage stability	3.2.2.6	ASTM F 1105	ASTM				
Shear stability	3.2.2.7						
Hard water stability	3.2.2.8	Annex A ASTM D 1193	ASTM				
Tendency to foam	3.2.2.9						
Cold storage stability	3.2.2.10	ASTM	ASTM				
Viscosity	3.2.3.1	ASTM D 445	ASTM				
Anti-icing performance	3.2.4	Annex A					



Unit
Swedavia Konsult

Prepared by
Fredrik Nilsson

Reference
Avisning av flygplan
T/FrNi 15:007

Technical Requirements	Ref. Para	Test Method	Publication	Max. / Min. Values	Remarks	Measured Test Result	Date
Aerodynamic acceptance	3.2.5	Annex B Annex C					
Freezing point	3.3.1	ASTM D 1193	ASTM				
Sandwich corrosion	3.3.2.1	ASTM D 1193 ASTM F 1110	ASTM				
Total immersion corrosion	3.3.2.2	ASTM F 483	ASTM				
Aluminium				max 0,3 mg/cm2 in percentage by weight	Period 24 h		
Magnesium				max 0,2 mg/cm2 in percentage by weight	Period 24 h		
Titanium				max 0,1 mg/cm2 in percentage by weight	Period 24 h		
Carbon steel				max 0,8 mg/cm2 in percentage by weight	Period 24 h		
Low-embrittling cadmium plate	3.3.2.3	ASTM F 1111	ASTM				
Stress-corrosion resistance	3.3.2.4	ASTM F 945	ASTM				
		AMS 4911/MAM 4911					
Hydrogen embrittlement	3.3.2.5	ASTM F 519 type 1a, 1c or 2a	ASTM				
Effect on transparent plastics	3.3.2.6	ASTM F 484 MIL-PRF-25960	ASTM				
Effect on painted surfaces	3.3.3	ASTM F 502	ASTM				
Effect on un-painted surfaces	3.3.4	ASTM F 485	ASTM				
Runway concrete scaling resistance	3.3.5.1	ASTM C 672	ASTM				
Quality assurance provisions	4						
Responsibility for inspection	4.1				Supply all samples for conformance testing and shall be responsible for obtaining independent laboratory confirmation of conformance		
Classification of tests	4.2				Date for last test. Technical requirements based on preproduction tests.		
Sampling and testing	4.3	ASTM D 4177 ASTM D 1568	ASTM				
Approval	4.4						
Reports	4.5						
Resampling and retesting	4.6						

Appendix C

Effect on bitumen and asphalt concrete pavement

Bitumen

The manufacturer shall document eventual effects of the de-/anti-icing agents on bitumen. The influence of the effects will be evaluated by storage and testing of bitumen manufactured of crude oil from Venezuela according to LFV Method 1-98 (rev. 2000-04). Storage at the temperatures 20°C and 40°C will be done in the regular highest concentration solution of the deicing product. Determination of softening point is performed and the result compared with the original softening point of material not stored in de-/anti-icing agent. The following laboratories can be contacted:

VTI, Linköping, Sweden	Björn Kalman (bjorn.kalman@vti.se)
SINTEF, Trondheim, Norway	Björn Ove Lerfald (bjorn.o.lerfald@sintef.no)
BAM, Berlin, Germany	Sabine Altkrueger (sabine.altkrueger@bam.de)
CRR, Brussels, Belgium	G Glorie (g.glorie@brrc.be)
Tecnotest AG, Rüslikon, Switzerland	Max Seeberger (m.seeberger@tecnotest.ch)

Storage and testing shall be performed and documented according to the text below. Time (day, hour) until dissolution of the binder shall in every case be documented at respectively stated temperature. Determination of density, concentration and pH-value of the de-/anti-icing agents shall be included.

Bitumen 160/220:

Temperature 20°C, storage time 24 hours

Bitumen B 50/70:

Temperature 20°C, storage time 1 week and 3 weeks

Temperature 40°C, storage time 24 hours

The difference in softening point for bitumen 50/70 after 3 week storage time in de-/anti-icing agent at 20°C shall not exceed 3°C.

Effect on asphalt concrete pavement

The manufacturer shall document eventual effects of the de-/anti-icing agents on asphalt concrete pavement. The influence of the effects will be evaluated by storage and testing of asphalt specimens according to LFV Method 2-98 (rev. 2005-01). The storage will be done with the regular highest concentration solution of the deicing product at 40°C.

The test will be performed with asphalt concrete pavement type ABT 16 with bitumen 160/220 and air void 7 % ± 1 % by volume. After 70 days storage time at 40°C a surface tensile strength test will be done at 23°C. The reduction in the adhesion value of the asphalt concrete surface shall not be more than 50 % of the adhesion value of the specimens not

stored in de-/anti-icing product. Determination of density, concentration and pH-value of the de-/anti-icing agent shall be included. The following laboratories can be contacted:

VTI, Linköping, Sweden
SINTEF, Trondheim, Norway
BAM, Berlin, Germany
CRR, Brussels, Belgium
Tecnotest AG, Rüslikon, Switzerland

Björn Kalman (bjorn.kalman@vti.se)
Björn Ove Lerfald (bjorn.o.lerfald@sintef.no)
Sabine Altkrueger (sabine.altkrueger@bam.de)
G Glorie (g.glorie@brrc.be)
Max Seeberger (m.seeberger@tecnotest.ch)

LFV METHOD 1-98 (rev. 2000-04)

Bituminous binders, storage in de-icing fluid

1. ORIENTATION

Storage in deicing fluid is performed to evaluate the effect of the fluid on bitumen used in airport runways. Examples of de-icing fluid include solutions of acetate, formate and urea.

2. SUMMARY

Two specimens of bitumen, cast in brass rings, are placed at the bottom of a bowl containing de-icing fluid and stored at a specified temperature for a specified time.

Determination of softening point is performed and the result compared with the original softening point of material not stored in de-icing fluid.

3. EQUIPMENT

3.1 Softening point rings and specimen preparation plate according to EN 1427 (a specimen preparation plate of glass can also be used).

3.2 A flat-bottomed storage bowl of glass, diameter approximately 140 mm, height approximately 30 mm.

4. SPECIMEN PREPARATION

Specimen preparation is performed according to EN 1427. After the rings have cooled and the surplus bitumen cut away, the storage phase begins.

5. STORAGE

Place the specimen preparation plate and softening point rings with the specimen in the storage bowl and carefully fill with de-icing fluid to a height of 7 ± 2 mm above the top of the specimen. Cover the bowl with a lid and store at the specified temperature for the specified time.

The concentration of the de-icing fluid must correspond to the highest concentration intended to be used (normally 50% for acetate, formate and urea).

A suitable storage temperature is $20 \pm 1^\circ\text{C}$ or $40 \pm 1^\circ\text{C}$.

The storage time may vary from 24 hours upwards. Normally, storage takes place for 24 hours \pm 30 minutes, 1 week \pm 30 minutes, 3 weeks \pm 30 minutes, or until dissolution of the binder occurs. (After storage at 40°C , the specimen is brought to room temperature (for at least 30 minutes) before testing according to EN 1427.)



6. TESTING

After storage, softening point determination is performed according to EN 1427. The softening point obtained is compared with that of binder not stored in de-icing fluid. The difference in softening point is stated.

7. REPORT

Report the following

- a) that the determination has been performed according to this method
- b) softening point (Ring and Ball), and the difference in softening point after storage
- c) storage temperature
- d) storage time
- e) type of binder (degree of penetration, e.g. bitumen 160/220)
- f) type of de-icing fluid (e.g. formiate, glycol) and product name
- g) density, pH value and concentration of the de-icing fluid

LFV METHOD 2-98 (rev 2005-01)

Effect of de-icing fluid on the surface tensile strength of asphalt concrete for airfields - Adhesion Test

1. INTRODUCTION

The purpose of the test is to determine the effect of storage in de-icing fluid on the surface tensile strength of asphalt concrete. The surface strength is the force in N/mm² required for failure to occur in the upper surface of the asphalt concrete under perpendicular "pull off" tension with an increase in tensile force of 200 N/s.

The test is performed largely in the same way as the method used for testing the adhesion of road markings to a road pavement and/or the adhesion of bridge deck waterproofing to an underlying concrete or steel surface.

2. TEST METHODS

2.1 Principle

Testing shall be performed on a sawn cylindrical test specimen on which a well-defined test surface has been carefully drilled out in the asphalt concrete to a depth of about 5 mm. A steel plate shall be bonded to the test surface. The specimen with test plate shall then be stored in de-icing fluid. During testing, the plate is pulled off with an increase in tensile force of 200 N/s, the force being applied perpendicularly to the test surface. The surface strength upon failure and the type of failure shall be recorded.

The results are compared with those for specimens which have not been stored in de-icing fluid.

2.2 Apparatus and materials

- a) Vessel with tight-fitting lid for storing specimens in de-icing fluid.
- b) Vacuum exsiccator.
- c) Vacuum pump for evacuation of the exsiccator. The pump shall be capable of achieving a pressure of 6,7 kPa within 10 min and maintaining this pressure (within $\pm 0,3$ kPa) throughout the vacuum treatment.
- d) Manometer for measuring absolute pressure in the exsiccator.
- e) Approved equipment for laboratory mixing of bituminous asphalt mixture.
- f) Approved equipment for compaction of Marshall specimens or other approved laboratory compaction equipment such as gyratory compaction machine, roller or vibrating hammer.

- g) Circular steel plates with a diameter of 50 mm and a tolerance of 0,5 mm. The steel plate shall be attached by suitable means (e. g. screwed) to the tensile test machine. Minimum thickness of steel plate shall be 10 mm from bottom of steel plate to bottom of screw hole.
- h) Suitable adhesive (e.g. two part epoxy resin) for bonding the steel plates to the test specimen.
- i) Base and holder for fixing the specimen prior to testing (see Fig. 1).
- j) Tensile test machine, with force increasing rate control and automatic load recording, fitted with suitable clampings and base to ensure that the tensile force can be applied without momentum perpendicular to the test specimen.
- k) Equipment for drilling out a test surface.
- l) Conditioning device giving a temperature of $(23 \pm 1) ^\circ\text{C}$.
- m) Circular saw capable of cutting asphalt with finish that has no imperfections discernible by touch.
- n) Heating cabinet giving a temperature of $(40 \pm 2) ^\circ\text{C}$ for heated storage of specimens.
- o) Exsiccator grease.

2.3 Preparation of test specimens

Produce a number of specimens by compaction according to Marshall or other laboratory compaction method. The specimens should have a diameter of (100 ± 5) mm and a height of (60 ± 10) mm. The asphalt mix may be produced in an asphalt mixing plant or in the laboratory.

2.4 Determination of dry weight and bulk volume

Allow the specimens to reach room temperature. Mark them with a waterproof marking. Store the specimens overnight in room temperature on a flat surface. The next day, determine the bulk density for each specimen according to EN 12697-6. Divide the specimens into two equal groups (a wet and a dry group) with regard to bulk density. The mean bulk density must not differ by more than 30 kg/m^3 between the groups.

2.5 Preparation of test surface

Saw the specimens in half and carefully drill a test surface with a diameter of 50 mm and a depth of about 5 mm approximately in the centre of the sawn surface of the specimen. Allow the specimens to dry on a flat surface at room temperature for at least three days. Bond the test plate to the test surface by carefully applying a thin layer of epoxy adhesive. Allow the specimen to cure at room temperature until the following day. Prepare the test surfaces of specimens from both groups.

2.6 Storage in de-icing fluid

Store the specimens with bonded test plate from the wet group in de-icing liquid at (40 ± 2) °C and perform the test at (23 ± 1) °C.

Store the specimens in de-icing fluid, first for 3 hours \pm 5 min under vacuum and room temperature, and then for a further 70 days \pm 1 hour at normal pressure and specified storage temperature. Four specimens are normally stored for testing.

Place the specimens with the test plate upwards in the exsiccator. Pour de-icing fluid at room temperature into the exsiccator to a level 2-3 cm above the top of the asphalt concrete surface. Evacuate to an absolute pressure of $6,7 \pm 0,3$ kPa within 10 ± 1 min. Adjust the evacuation rate and pressure with a valve or rubber hose with clamp.

Keep the absolute pressure at $(6,7 \pm 0,3)$ kPa for 3 hours. Turn off the pump and carefully admit air into the exsiccator until atmospheric pressure is reached.

Continue storage in a vessel at (40 ± 2) °C for a further 70 days \pm 1 hour. Here again, the specimens must be placed with the test plate upwards immersed in de-icing fluid to a level 2-3 cm above the top of the asphalt concrete specimen surface. During storage, the vessel shall be covered with a tight-fitting lid. At the same time, the group of dry specimens is stored on a flat surface at room temperature.

After storage, condition the specimens to test temperature in the de-icing fluid not longer than until the next day.

2.7 Procedure

Take the specimen out of the de-icing fluid. Directly fix the specimen in the tensile test machine and the test plate attached to the machine. Apply the tensile force perpendicularly to the test surface and perform the test with an increase in tensile force of 200 N/s until failure occurs.

Record the tensile force together with the mode of failure. The following general modes of failure may occur:

- in the asphalt concrete, 5mm or deeper;
- superficially in the asphalt concrete surface;
- adhesive failure.

The test is carried out at (23 ± 1) °C.

At least three valid tests shall be carried out. The mean surface strength shall be calculated from a minimum of three accepted test results.

Test results for specimens stored in de-icing fluid are compared to test results for not stored specimens.

2.8 Expression of results

2.8.1 Method of calculation

The surface strength shall be calculated, to the nearest 0,1 N/mm², as the stress at maximum force by the following equation:

$$\sigma_{\max} = \frac{F_{\max}}{A}$$

where:

σ_{\max} surface strength at failure, in N/mm²

F_{\max} recorded maximum force, in N

A test area, in mm²

The mean value of the three test results shall be calculated.

2.8.2 Precision of the test method

Reproducibility and repeatability of the test method have been determined in accordance with ISO 5725 for 7 laboratories using different equipment. The experiment was done on gyratory compacted test specimens with maximum particle size 16 mm and void content 7 %. The origin of the aggregate was Skärlanda in Östergötland, the binder was a Laguna 160/220 and the nominal binder content was 5,7 % by weight. Five different storage agents were used.

Results relating to σ_{\max} (6 laboratories, 1 excluded by statistical tests):

repeatability, standard deviation: $s_r = 130$ N

repeatability, critical range at 95 % confidence level
when testing three specimens: $s_r = 130$ N

reproducibility, standard deviation: $s_R = 220$ N

2.9 Test report

The test report shall include at least the following information:

- all details necessary to identify the de-icing product tested (such as type, product name, density, pH value and concentration);
- a reference to this method and any deviation from it;
- information on preparation of test specimens in accordance with clause 2.3, type of asphalt, including aggregate and bitumen designation;
- bulk density of all specimens and mean and SD for each group according to clause 2.4;
- information on storage according to clause 2.6;
- the test results and failure mode according to clause 2.7 for each individual test, mean values;

- the dates of delivery and preparation of specimens;
- the date of tests.

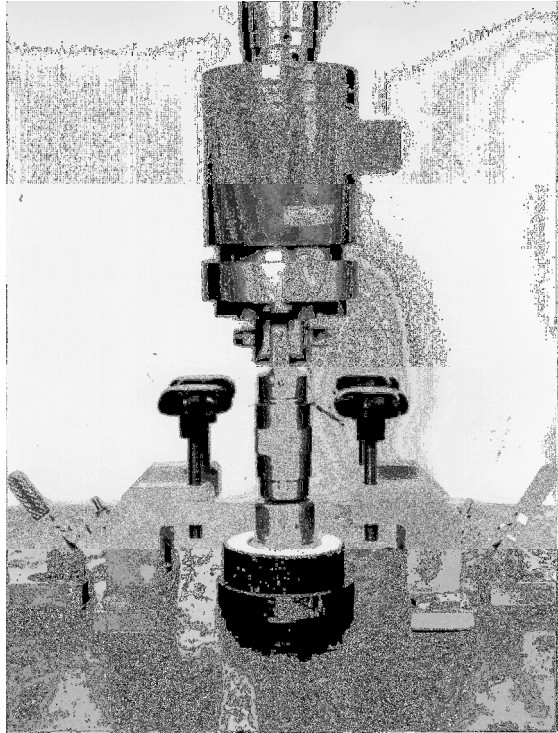


Figure 1 *Example of base, test specimen and equipment for adhesion testing (road markings).*

Appendix D

Technical properties

General:

The vendors shall document:

Holdover times

Generic and specific holdover time tables for the de-/anti-icing agents shall be presented.

Recycling of de-/anti-icing agents

The vendor shall present a method to recycle the de-/anti-icing agents. The following shall be presented:

- a method to separate type II- and/or type IV-fluid from type I-fluid or
- a method to handle the recycled fluid as a type I-fluid through the recycling process or a method to recycle type II- and/or type IV-fluids
- any reference facilities of glycol recycling

Technical properties

The de-/anti-icing agents shall have low tenside content. Any included tensides shall be non-ionic.

Appendix E

Environmental requirements for de-/anti-icing chemicals

Area	Hazard Class	Hazardous category
Human toxicity	3.1 Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3
	3.2 Skin corrosion/irritation	Skin Corr. 1A Skin Corr. 1B Skin Corr. 1C
	3.3 Serious eye damage	Eye Dam. 1
	3.4 Respiratory or skin sensitisation	Resp. Sens. 1/1A/1B
	3.5 Germ cell mutagenicity	Muta. 1 A Muta. 1B Muta. 2
	3.6 Carcinogenicity	Carc. 1A Carc. 1B Carc. 2
	3.7 Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2
	3.8 Specific Target Organ Toxicity – Single exposure	STOT SE 1 STOT SE 2
	3.9 Specific Target Organ Toxicity – Repeated exposure	STOT RE 1 STOT RE 2
	3.10 Aspiration hazard	Asp. Tox.1

5 ENVIRONMENTAL REQUIREMENTS FOR EXISTING SUBSTANCES

Each substance the product contains **shall** comply with the following requirements for biodegradability and bioaccumulation.

Test	Method	Requirement
Bioaccumulation	OECD Guideline 117 For surface active chemicals expert judgement or BCF test results can be used	Log Pow < 4,5 BCF < 2000 (applicable for surface active chemicals)
Biodegradability	OECD 301 A-F	Ready biodegradability

If a substance fails to achieve any requirement Swedavia can still accept the substance after a case-by-case evaluation.

6 TRACE CONTAMINANTS

The product **shall not** contain trace contaminants above following levels:

Substance	Level
Lead (Pb)	<1 ppm (<0.0001%)
Chromium (Cr)	<1 ppm (<0.0001%)
Cadmium (Cd)	<1 ppm (<0.0001%)
Mercury (Hg)	<1 ppm (<0.0001%)
Zinc (Zn)	<1 ppm (<0.0001%)
Copper (Cu)	<1 ppm (<0.0001%)
Nickel (Ni)	<1 ppm (<0.0001%)

7 TEST MEASURING THE ENVIRONMENTAL PERFORMANCE OF THE PRODUCT

The test shown in the table below **shall** be presented as test report for each substance.

Test	standard
<i>Acute toxicity Algae :</i>	OECD 201/ISO 8692
<i>Acute toxicity Crustacean :</i>	OECD 202/ISO 6341
<i>Chronic toxicity Crustacean:</i>	OECD 211
<i>Bioaccumulation:</i>	OECD Guideline 117
<i>Ready biodegradation</i>	Freshwater biodegradability: OECD-test 301A – F
Nitrification inhibition test	OECD 209/ ISO 9509
Respiration inhibition test	OECD 209

Other analyses/tests the manufacturer may have carried out as documentation of environmental properties of the product or each substance **shall** be presented.

8 THE PRODUCTS REGISTER

Manufacturers and importers are obliged to register products subject to chemicals control. Chemical products **shall** be notified to the Products Register by companies manufacturing, packaging, delivering or supplying them to Sweden.

If the manufacturing company exports the product directly to Swedavia without middlemen, the manufacturing company **shall** notify the Products Register, at the Swedish Chemicals Agency (<http://www.kemi.se/en/Start/The-Products-Register/>)

Appendix F

Working environment.

The airport authorities shall have free access through safety representatives and other parties as defined by the airport authorities concerned to written documentation in the national language of the buyer regarding the composition/information on ingredients of the complete product content of the de-/anti-icing product.

The objective with this documentation is to provide the buyer with written documentation regarding the known effects on the working environment, health of persons and the environment handling the de-/anti-icing product.

The vendor shall provide material safety data sheets written in Swedish.

Additional information (mandatory) shall be provided as follows:

- Suitable materials for storage tanks:
.....
.....
- The de-/anti-icing agent's shelf life when stored accordingly:
.....
.....
- Protective equipment required to ensure a safe working environment:
.....
.....
- Materials used in such protective equipment (clothing, etc):
.....
.....
- Known situations where handling the de-/anti-icing agent is not recommended, e.g. when wearing contact lenses:
.....
.....
- Known short-term and long-term effects on persons exposed to the de-/anti-icing agent:
.....
.....
- Known effects of exposure and inhalation of aerosols, e.g. aerosol mist:
.....
.....

The chemical data sheets shall be updated immediately when new information on safety, protective equipment or the environment is available. New versions of data sheets must be clearly marked with version number and date.