AEROSPACE
STANDARD

AS6285™

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Aircraft Ground Deicing/Anti-Icing Processes

RATIONALE

The purpose of this document is to provide industry standards for the methods and procedures used in performing the treatments necessary for the proper deicing and anti-icing of aircraft on the ground using AMS1424 and AMS1428 qualified fluids (Type I, II, III, and IV) and non-fluid methods.

Exposure to weather conditions on the ground that are conducive to ice formation can cause the accumulation of frost, snow, slush, or ice on aircraft surfaces and components. These contaminants can adversely affect aircraft performance, stability and control, and operation of mechanical devices such as control surfaces, sensors, flaps, and landing gear. If frozen deposits are present, other than those considered in the aircraft certification process, the performance of the aircraft may be compromised.

Regulations governing aircraft operations in icing conditions shall be followed. Specific rules for aircraft are set forth in the United States Federal Aviation Regulations (FAR), EASA EU-OPS, Canadian Aviation Regulations (CAR), and others. Paraphrased, these rules specify that no one may dispatch or take off an aircraft with frozen deposits on components of the aircraft that are critical to safe flight. A critical surface or component is one which could adversely affect the mechanical or aerodynamic function of an aircraft.

As individual icing situations or aircraft types and models may require special procedures, this document can never replace the aircraft operator’s judgement. The responsibility for the correct deicing and anti-icing procedures for aircraft always rests with the operator of the aircraft.

The ultimate responsibility for the determination that the aircraft is clean and meets airworthiness requirements rests with the pilot in command of the aircraft.

SAE values your input. To provide feedback on this Technical Report, please visit http://www.sae.org/technical/standards/AS6285
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1. SCOPE

1.1 Field of Application

This document establishes the minimum requirements for ground based aircraft deicing/anti-icing methods and procedures to ensure the safe operation of aircraft during icing conditions on the ground. This document does not specify the requirements for particular aircraft models.

NOTE: Refer to particular aircraft operator or aircraft manufacturers' published manuals and procedures.

The application of the procedures specified in this document are intended to effectively remove and/or prevent the accumulation of frost, snow, slush or ice contamination which can seriously affect the aerodynamic performance and/or the controllability of an aircraft. The principal method of treatment employed is the use of fluids qualified to AMS1424 and AMS1428 (Type I, II, III, and IV fluids).

All guidelines referred to herein are applicable only in conjunction with the applicable documents. Due to aerodynamic and other concerns, the application of deicing/anti-icing fluids shall be carried out in compliance with engine and aircraft manufacturers’ recommendations.

1.2 Agreements and Contracts

This information is recommended as a basis for operations and service support agreements.

1.3 Hazardous Materials

While the materials, methods, applications, and processes referenced to, or described in this specification may involve the use of hazardous materials, this standard does not address the hazards which may be involved in their use. It is the sole responsibility of the user to ensure their familiarity with the safe and proper use of any hazardous materials and processes and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. REFERENCES

2.1 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.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS1424 Deicing/Anti-Icing Fluid, Aircraft SAE Type 1
AMS1428 Fluid, Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, IV
ARP1971 Aircraft Deicing Vehicle – Self-Propelled
ARP5058 Enclosed Operator's Cabin for Aircraft Ground Deicing Equipment
AS5116 Minimum Operational Performance Specification for Ground Ice Detection Systems
ARP5660 Deicing Facility Operational Procedures
AS5681 Minimum Operational Performance Specification for Remote On-Ground Ice Detection Systems


AIR6232 Aircraft Surface Coating Interaction with Aircraft Deicing/Anti-icing Fluids

AIR6284 Forced Air or Forced Air/Fluid Equipment for Removal of Contaminants

AS9968 Laboratory Viscosity Measurement of Thickened Aircraft Deicing/Anti-icing Fluids with the Brookfield LV Viscometer

Aircraft Manufacturer Manuals

Aircraft Operator Manuals

2.2 Abbreviations and Definitions

2.2.1 Abbreviations

ACARS Aircraft Communications Addressing and Reporting System

ATC Air Traffic Control

APU Auxiliary Power Unit

CDF Central Deicing Facility

DDF Designated Deicing Facility

°C Degrees Celsius

°F Degrees Fahrenheit

EFB Electronic Flight Bag

EMB Electronic Message Board

FAA Federal Aviation Administration

FP Freezing Point

h Hours

LOUT Lowest Operational Use Temperature

min Minutes

OAT Outside Air Temperature

SDS Safety Data Sheet

TC Transport Canada
2.2.2 Definitions

For the purposes of this document, the following definitions apply.

a. Advisory Word Definitions: The following advisory words are to be used as defined:

   MAY: This is used to describe that the practice is encouraged and/or optional.

   SHALL: This will mean that the practice is mandatory.

   SHOULD: This means that the practice is recommended or strongly encouraged.

b. Words and Phrase Definitions: The following words and phrases are to be used as defined:

   ACTIVE FROST: Active frost is a condition when frost is forming. Active frost occurs when aircraft surface temperature is at or below 0 °C (32 °F) when the humidity of the air is at or below dew point.

   ANTI-ICING: Procedure by which fluid is applied to provide protection against the formation of frost or ice or the accumulation of snow or slush on treated surfaces of an aircraft for a limited period of time (Holdover Time).

   ANTI-ICING FLUID:
   a. Mixture of water and Type I fluid;
   b. Premix Type I fluid;
   c. Type II fluid, Type III fluid, or Type IV fluid;
   d. Mixture of water and Type II fluid, Type III fluid, or Type IV fluid.

   NOTE: Fluids in (a) and (b) shall be heated to ensure a temperature of 60 °C (140 °F) minimum at the nozzle.

   SAE Type II and IV fluids for anti-icing are normally applied unheated on clean aircraft surfaces but may be applied heated. SAE Type III fluids for anti-icing may be applied heated or unheated on clean aircraft surfaces.

   ANTI-ICING CODE: This code is given to the flight crew/Pilot in Command that deicing/anti-icing has been carried out and the details of the anti-icing treatment that was applied.

   BUFFER (FREEZE POINT BUFFER): The difference between the Outside Air Temperature (OAT) and the of the fluid used.

   CHECK: The examination of an aircraft item against a relevant standard by a trained and qualified person.

   COLD-SOAK EFFECT: The wings of an aircraft are said to be “cold-soaked” when they contain very cold fuel as a result of having just landed after a flight at high altitude or from having been refueled with very cold fuel.

   Whenever precipitation falls on a cold-soaked aircraft on the ground, clear icing may occur. Even in ambient temperatures between -2 and +15 °C (28 and 59 °F), ice or frost can form in the presence of visible moisture or high humidity if the aircraft structure remains at 0 °C (32 °F) or below.

   Clear ice is very difficult to detect visually and may break loose during or after takeoff. The following factors contribute to cold-soaking: temperature and quantity of fuel in fuel cells, type and location of fuel cells, length of time at high altitude flights, temperature of refueled fuel, and time since refueling.
COLD SOAKING: Ice can form even when the outside air temperature (OAT) is well above 0 °C (32 °F). An aircraft equipped with wing fuel tanks may have fuel that is at a sufficiently low temperature such that it lowers the wing skin temperature to below the freezing point of water. If an aircraft has been at a high altitude, where cold temperature prevails, for a period of time, the aircraft’s major structural components such as the wing, tail, and fuselage will assume the lower temperature, which will often be below the freezing point. This phenomenon is known as cold soaking. While on the ground, the cold soaked aircraft will cause ice to form when liquid water, either as condensation from the atmosphere or as rain, comes in contact with cold soaked surfaces.

COLD SOAKED CLEAR ICE: This is the formation of ice, normally in the area of the wing fuel tanks, caused by the cold soak effect. Clear ice is very difficult to be detected visually and may break loose during or after takeoff, and poses a hazard particularly to aircraft with rear fuselage mounted engines.

COLD SOAKED FUEL FROST: This is the formation of frost, normally in the area of the wing fuel tanks, caused by the cold soak effect.

COLD SOAKED WING ICE/FROST: Water, visible moisture, or humidity forming ice or frost on the wing surface, when the temperature of the aircraft wing surface is at or below 0 °C (32 °F).

CONTAMINATION: Contamination is defined as all forms of frozen or semi-frozen deposits on an aircraft, such as frost, snow, slush, or ice.

CONTAMINATION CHECK: A check of aircraft surfaces and components for contamination to establish the need for deicing.

DEICING: Procedure by which frost, snow, slush, or ice is removed from an aircraft in order to provide clean surfaces and components.

DEICING/ANTI-ICING: Combination of or referring to both of the procedures for ‘deicing’ and ‘anti-icing’. It may be performed in one or two steps.

DEICING SERVICE PROVIDER: The company responsible for the aircraft deicing/anti-icing operations on an airfield.

DEICING FLUID:

a. Heated water;

b. Heated mixture of water and Type I fluid;

c. Heated premix Type I fluid;

d. Heated Type II, Type III, or Type IV fluid;

e. Heated mixture of water and Type II, Type III, or Type IV fluid.

NOTE: The effect of unheated deicing fluid is minimal.

FREEZING DRIZZLE: Fairly uniform precipitation composed exclusively of fine drops [diameter less than 0.5 mm (0.02 inch)] very close together which freeze upon impact with the ground or other exposed objects.

FREEZING FOG: A suspension of numerous very small water droplets which freeze upon impact with the ground or other exposed objects; generally reduces the horizontal visibility at the earth’s surface to less than 1 km (5/8 mile).

FROST/HOAR FROST: Frost is the tiny solid deposition of water vapor from saturated air which occurs when the temperature of a surface is below 0 °C (32 °F). Frost generally occurs generally with clear skies at temperatures below freezing the point.
FREEZING RAIN (LIGHT): Precipitation of liquid water particles which freezes upon impact with the ground or other exposed objects, either in the form of drops of more than 0.5 mm (0.02 inch) or smaller drops which, in contrast to drizzle, are widely separated. Measured intensity of liquid water particles is up to 2.5 mm/hour (0.10 inch/hour) or 25 grams/dm²/hour with a maximum of 0.25 mm (0.01 inch) in 6 minutes.

HAIL: Precipitation of small balls or pieces of ice with a diameter ranging from 5 to 50 mm (0.2 to >2.0 inches) falling either separately or agglomerated

HOLDOVER TIME: Estimated time for which an anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the treated surfaces of an aircraft.

ICE PELLETS: Precipitation of transparent (grains of ice), or translucent (small hail) pellets of ice, which are spherical or irregular, and have a diameter of 5 mm (0.2 inch) or less. Ice pellets usually bounce when hitting hard ground.

LOCAL FROST: The limited formation of frost in localized wing areas cooled by cold fuel or large masses of cold metal in the wing structure; this type of frost does not cover the entire wing.

LOWEST OPERATIONAL USE TEMPERATURE (LOUT): The higher (warmer) of:

- The lowest temperature at which the fluid meets the aerodynamic acceptance test (according to AS5900) for a given type (high speed or low speed) of aircraft, or,
- The freezing point of the fluid plus the buffer of 10 °C (18 °F) for Type I fluid and 7 °C (13 °F) for Type II, III, or IV fluids.

For applicable values, refer to the fluid manufacturer’s documentation.

MODERATE AND HEAVY FREEZING RAIN: Precipitation of liquid water particles which freezes upon impact with the ground or other exposed objects, either in the form of drops of more than 0.5 mm (0.02 inch) or smaller drops which, in contrast to drizzle, are widely separated. Measured intensity of liquid water particles is more than 2.5 mm/hour (0.10 inch/hour) or 25 grams/dm²/hour.

NEGATIVE BUFFER: A negative buffer exists when the freezing point of a deicing fluid is above the OAT (see Tables 1 or 2 for “first step” application limits).

PROXIMITY SENSOR: A proximity sensor is a safety feature on some models of deicing equipment, that upon activation disengages relevant systems, preventing equipment movement and damage from occurring due to physical contact between equipment components (e.g., spray nozzle, forced air nozzle, operator basket, etc.,) and aircraft surfaces. As a safety mechanism, the proximity sensor is designed to prevent damage from occurring to aircraft surfaces, normally while the equipment chassis is in a stationary position (not maneuvering). Where equipped, the type of sensor used may vary by design, and may activate either by physical contact (e.g., a proximity switch with contact mechanism), or by non-physical activation (e.g., infrared, radar, etc.).

REFRACTIVE INDEX: Refractive index is the comparative speed of light in different transparent media. The difference in this speed leads to refraction (bending of the light) which can be used to measure the composition of the media. In the case of water and glycol mixture, this refraction can be used to accurately determine the percentage of glycol in the water.

QUALIFIED STAFF: Trained staff who have passed theoretical and practical training tests and have been certified for performing this type of job, see AS6286 training and qualification program.

REFRACTOMETER: An optical instrument designed to measure the refractive index of water soluble fluids.

RESIDUE/GEL: A buildup of dried out thickened fluids typically found in aerodynamically quiet areas of the aircraft.

RIME ICE: Small, frozen, spherical water droplets, opaque/milky and granular in appearance, which looks similar to frost in a freezer; typically rime ice has low adhesion to the surface and its surrounding rime ice particles.
SLUSH: Slush is snow or ice that has been combined with water.

SNOW: Snow is a precipitation of ice crystals, most of which are branched, star-shaped or mixed with unbranched crystals. At temperatures higher than -5 °C (23 °F), the crystals are generally agglomerated into snowflakes.

SNOW GRAINS: Precipitation of very small white and opaque particles of ice that are fairly flat or elongated with a diameter of less than 1 mm (0.04 inch); when snow grains hit hard ground, they do not bounce or shatter.

NOTE: For holdover time purposes, treat snow grains as snow.

SNOW PELLETS: Precipitation of white, opaque particles of ice; the particles are round or sometimes conical; their diameters range from approximately 2 to 5 mm (0.08 to 0.2 inch); they are brittle and easily crushed; they do bounce and may break upon contact with hard ground.

NOTE: For holdover time purposes, treat snow pellets as snow.

STORAGE TANK: A vessel for holding fluid that can be fixed, or mobile; includes rolling tanks (ISO tanks), totes, trailers, or drums.

TACTILE CHECK: A tactile check requires a person to touch specific aircraft surfaces. Tactile checks, under certain circumstances, may be the only way of confirming the critical surfaces of an aircraft are not contaminated. For some aircraft, tactile checks are mandatory as part of the deicing/anti-icing check process to ensure the critical surfaces are free of frozen contaminants.

3. ROLES AND RESPONSIBILITIES

3.1 Pilot in Command

The pilot in command has the ultimate responsibility for the aircraft and shall not commence take-off unless the external surfaces are clear of any deposit which might adversely affect performance and/or controllability except as permitted in the Operators Manuals.

3.2 The Aircraft Operator shall have responsibility for:

- Aircraft Ground Deicing Programs
- The Pilot in Command
- Management Responsibilities

3.3 The Deicing Service Provider shall have the responsibility for:

- The safety and operability of the Designated Deicing Facilities
- Aircraft Ground Deicing/Anti-icing Procedures.

A Deicing Service Provider shall have aircraft deicing/anti-icing procedures, including a quality control program. These procedures, which ensure compliance with the relevant regulations, shall cover all aspects of the aircraft ground deicing/anti-icing process including (but not limited to) instructions, tasks, responsibilities, authorizations and infra-structure for the deicing/anti-icing process as follows:

- Use of suitable deicing/anti-icing treatment method according this Aerospace Standard

- Remote deicing/anti-icing instructions (when applicable).

- Sufficient number of trained and qualified deicing/anti-icing personnel.
• Qualified Staff to co-ordinate and supervise the deicing/anti-icing treatments.
• Use of suitable deicing/anti-icing equipment meeting specification ARP1971 and/or ISO 11077.
• Special handling procedures for Type II, III and IV deicing/anti-icing fluids to maintain quality.
• Post treatment check (when applicable).
• Protocol for communications with cockpit crew for both gate and remote locations (when applicable).
• Reporting the anti-icing code to the cockpit crew (when applicable).
• Documentation of all deicing/anti-icing treatments.
• Personnel safety arrangements.
• Provisions for tools and clothing for deicing/anti-icing personnel.
• Environmental arrangements.
• A quality control program.

3.4 Airports shall have the responsibility for:
• Following local environmental regulations
• The logistics of bringing fluid onto a field
• The operability of the Dedicated Deicing Facilities
• Message Boards
• Weather Support
• Health and Safety

3.5 The Regulatory Authority has the responsibility for:
• Regulatory and guidance material, plus the operation of the clean airplane concept
• The policies and standards that support the operability of the clean airplane concept
• Airline Operator ground deicing programs

3.6 Air Traffic Control has the responsibility for:
• The flow of aircraft through the regional system

4. QUALITY

All companies providing deicing/anti-icing services shall have a Quality Program. The purpose of the program is to ensure that deicing/anti-icing of aircraft on the ground is accomplished in accordance with regulatory requirements and guidance, industry standards and the operator’s program. To verify effectiveness of the deicing/anti-icing of aircraft on the ground, the Quality Program should include both Quality Assurance (QA) and Quality Control (QC) processes and procedures.
4.1 Quality Assurance

To meet Quality Assurance (QA) requirements, a company must provide proof it follows the rules and instructions in any specific field correctly and that it has a proper and efficient Quality Control Program. Quality Assurance is confirmed by auditing. Sometimes ‘Audit Pools’ are formed so that companies are not audited several times on the same process by different entities; for example: IATA’s Deicing/Anti-icing Quality Control Pool (DAQCP). All companies should have a Quality Assurance Program in place. Quality assurance programs shall follow the standards published in AS6332.

4.2 Station Quality Control Program

A Quality Control Program shall cover all aspects of aircraft ground deicing/anti-icing and shall include, but is not limited to, the following checks:

- Procedures and instructions up-to-date
- Responsibilities and tasks clearly defined and up-to-date
- Communication procedures/protocols up-to-date
- All personnel trained and qualified
- The quality of deicing/anti-icing fluid from all storage tanks, all equipment tanks and all spray nozzles are within limits
- Correct and safe functioning of deicing/anti-icing spray equipment
- Correct and safe functioning of (remote/centralised) deicing/anti-icing facility if applicable.
- Reporting methods and reports up-to-date

NOTE: Prior to the start of each winter, perform all above listed checks.

NOTE: During each winter season perform quality control checks on deicing/anti-icing fluids from all spray nozzles at operational settings on a regular basis and file test results till the start of the next winter period.

4.3 Fluid Quality Control Checks

To ensure the necessary safety margins are maintained in the deicing/anti-icing operation, the fluid used to both de-ice and anti-ice aircraft surfaces, must meet specification and be at the correct concentration. Factors like pumping, storing, heating, and spraying may cause degradation/contamination of deicing/anti-icing fluids. To assure the correct quality of these fluids, follow fluid manufacturer’s recommendations and perform the following checks. Results of all testing shall be recorded.

4.3.1 Fluid Delivery/Acceptance Check

a. Check of documentation on each delivery.

Check that the fluid delivered corresponds to the fluid ordered. Make sure the brand name and concentration of the product specified in the delivery documents corresponds to the delivered fluid. Each container/tank truck shall be checked. Make sure that the brand name and the concentration of the delivered fluid corresponds to the brand name and the concentration of the storage or equipment tanks.

Verify each delivery (container/tank truck) has an associated fluid certificate of conformity (C of C). The C of C, at a minimum shall include test results conforming to the three (four for thickened fluids) items listed directly below. Additionally, the fluid manufacturer shall give assurances on the condition of each container and/or bulk loaded delivery tanker trailer. This should be through cleaning certification documentation or previous load documentation.
In the absence of these items (C of C and container/trailer status) the receiving organization shall perform the following checks.

b. Fluid sample checks

Before the first use of the delivered fluid for filling a storage tank or equipment tank, take a sample from the container/tank truck (each separate compartment if applicable) and perform the following checks:

1. Visual examination for color and foreign body contamination
2. Concentration by a Refractive Index check
3. pH (*)
4. Viscosity check for thickened (Type II, III, and IV) fluids

All results shall be within the limits set by the applicable fluid manufacturer.

* Perform this check if it is suitable to detect degradation of the fluid used.

4.3.2 Fluid Pre-Season and Within-Season Checks

4.3.2.1 Type I Fluid

Checks shall be performed:

• At the start of the deicing season
• For each vehicle, at least one within-season nozzle sample check should be done
• On any vehicle or storage tank when fluid contamination or degradation is suspected

Fluid samples shall be taken from all deicing/anti-icing fluid spray nozzles of all deicing/anti-icing spraying equipment in the most common concentrations used for deicing/anti-icing and from all storage tanks in use. For vehicles without a mixing system, the sample may be taken directly from the vehicle pre-mix tank after ensuring that the fluid is at a uniform mixture. Perform the following checks on the fluid samples:

• Visual examination
• Refractive Index
• pH (*)

* Perform this check if it is suitable to detect degradation of the fluid used.

4.3.2.2 Type II, Type III, and Type IV Fluids

Checks shall be performed:

• At the start of the deicing season
• For each vehicle, at least one within-season nozzle sample check should be done
• On any vehicle or storage tank when fluid contamination or degradation is suspected
• After equipment maintenance on the fluid pump and spray system that has the potential to affect the quality of the fluid (e.g., pumps, nozzles, etc.).
Fluid samples shall be taken from all deicing/anti-icing fluid spray nozzles of all deicing/anti-icing spraying equipment for all of the concentrations used for anti-icing and from all storage tanks in use. Perform the following checks:

- Visual examination
- Refractive Index
- pH (*)
- Laboratory viscosity

* Perform this check if it is suitable to detect degradation of the fluid used.

4.3.2.3 Fluid Sample Check Requirements

- Results of the visual, refractive index, and pH checks shall be within the limits set by the applicable fluid manufacturer.

- Results of viscosity checks on samples from spray nozzles shall be within the limits set for use of the applicable holdover time table and for aerodynamic acceptance (Lowest On-Wing Viscosity and Highest On-Wing Viscosity).

- Results of viscosity checks on samples from storage tanks shall be within the limits needed to ensure fluid viscosity will meet applicable holdover time table requirements taking into account any expected degradation during the use of fluid application equipment and to ensure aerodynamic acceptance (Lowest On-Wing Viscosity and Highest On-Wing Viscosity).

4.3.3 Daily Concentration Checks

Fluids or fluid/water mixture samples shall be taken from the deicing/anti-icing equipment nozzles on a daily basis when the equipment is in use. Perform a refractive index check on the samples taken. The sample shall be protected against precipitation. Combustion heaters and trucks shall not be operated in confined or poorly ventilated areas to prevent asphyxiation. Requirements for suitable equipment are described in ARP1971.

NOTE 1: Equipment without a mixing system: samples may be taken from the mix tank instead of the nozzle. Ensure the fluid is at a uniform mix.

NOTE 2: Equipment with proportional mixing systems: operational setting for the flow and pressure shall be used. Allow the selected fluid concentration to stabilize before taking a sample.

NOTE 3: Equipment with automated fluid mixture monitoring system: the interval for refractive index checks has to be determined by the handling company in accordance with the system design.

4.3.3.1 Type I Fluid from Nozzles

- Maximum permitted concentration shall not be exceeded.

- For use in a 1-step method and in the 2nd step of a 2-step method, the concentration shall be such that the of the fluid is at least 10 °C (18 °F) below the OAT.

- For use in the 1st step of a two-step method, the concentration shall be such that the freezing point of the fluid is at the OAT or below.
4.3.3.2 Type 1 Fluid in Tanks

- The concentration shall be within the ‘in-service’ limits published by the manufacturer for fluid at the applicable concentration.

4.3.3.3 Type II, III, and IV Fluid

- For fluids from nozzles and in tanks, the concentration shall be within the ‘in-service’ limits published by the manufacturer for fluid at the applicable concentration.

- For Type II, III, and IV fluid/water mixtures (50/50 or 75/25) a tolerance range of 0 to +7% from the setting may apply, depending on the product.

4.3.4 Check on Directly or Indirectly Heated Type II, III, or IV Fluids

SAE Type II, III, and IV deicing/anti-icing fluids, if heated (directly or indirectly), shall be heated in a manner to preclude fluid degradation in storage or application. The integrity of the fluid following heating shall be checked periodically. Factors like heating rate and heating time cycles should be considered in determining the frequency of fluid inspections. Refer to the fluid manufacturers’ recommendations.

4.3.5 Fluid Check Methods

The following checks may be performed by any equivalent method.

a. Visual Contamination Check
   - Put fluid from the sample into a clean glass bottle
   - Check for any kind of contamination (e.g. rust particles, debris, rubber or discoloration, etc.)

b. Refractive Index Check
   - Perform a functionality test on the Refractometer
   - Put a fluid drop taken from the sample or from the nozzle onto the test screen of the refractometer and close the cover plate
   - Read the value on internal scale and use the correction factor given by the manufacturer of the fluid in case the temperature of the Refractometer is not 20 °C (68 °F)
   - Compare the value with the refractive index limits to determine concentration
   - Clean the Refractometer and return it into the protective cover

c. pH Value Check

   This check may be performed either with pH indicator paper (litmus paper) or with a calibrated or functionally tested pH meter. Read the value and compare with the limits for the fluid.

   NOTE: In the laboratory this pH check shall be performed with a calibrated or functionally tested pH meter.

d. Field viscosity check

   This check may be performed using the fluid manufacturers recommended method, like a falling ball or the Stoneybrook device. Read the value and compare with the limits for the fluid.
e. Laboratory viscosity test

- Perform the viscosity test using AS9968
- Compare the viscosity values with the applicable limits

4.3.6 Fluid Sampling Procedure for Type II, Type III, or Type IV Fluids

To ensure that the necessary safety margins are maintained between the start of the deicing/anti-icing operation and takeoff, the fluid used to both de-ice and anti-ice aircraft surfaces must meet specification and be at the correct concentration. Due to the possible effect of vehicle/equipment heating and/or delivery system components on fluid condition, it is necessary for the sampling method to simulate typical aircraft application. This section describes some methods for collecting samples of Type II, III, and IV fluids, sprayed from operational aircraft deicing/anti-icing vehicles and equipment, prior to the necessary quality control checks being carried out.

a. Method using a purpose built stand

Spray the fluid onto a purpose built stand, consisting of a suitable plate (for application) and an associated fluid collection system. In the absence of such a stand, a suitable apparatus can be used. The distance between the spray nozzle and the surface shall be approximately 1 to 3 m and the fluid shall be sprayed perpendicular to the surface. By following this simple procedure, a representative nozzle sample can be obtained. If there are any questions about the deicing fluid, contact and consult the fluid manufacturer. If there are any questions about the deicing vehicle or unit, pump, pump pressure, etc., consult the ground service equipment shop or the vehicle manufacturer.

- Select the required flow rate/spray pattern for the fluid to be sampled simulating routine operations.
- Spray the fluid to purge the lines and check the concentration of a sample, taken from the gun/nozzle after purging.
- Should the refractive index indicate that the lines have not been adequately purged, repeat the previous step until the concentration is correct for the fluid to be sampled (on certain vehicles it may be necessary to spray more than 50 litres of fluid, before the lines are completely purged).
- Direct the fluid onto the sampling surface and spray an adequate amount of fluid to allow for a 1 litre sample to be taken.

b. Trash can method: items required:

- Large garbage cans, buckets, or 55 gallon drums
- Large trash can liners
- Sample bottle that is clean and dry

Procedure for nozzle sample:

- Set trash cans out and put 2 liners in each trash can
- Weigh the trash can down with sand or blocks
- Stand about ±1 to 3 meters or 4 to 10 feet away from the cans
- Open the nozzle and spray into 1 of the trash cans so that the lines are purged of any old fluid
- When the line has been purged, move the nozzle to the next trash can, keeping the nozzle open
• Do not close the nozzle and restart as that will shear the fluid

• Spray 2 to 3 gallons (8 to 12 litres) into the second trash can

• Pull the liner out and put a small hole in bottom of bag to fill the sample bottle

c. Sample Identification

Attach a label to each sample bottle providing the following data:

• Manufacturers’ brand name and full name and Type of the fluid (e.g., Kilfrost ABC-3/Type II)

• Identification of deicing/anti-icing equipment (e.g., Elephant Beta DT04, Fixed Rig R001, etc.)

• Detail where the sample was taken from (e.g., nozzle, storage tank, or equipment tank)

• Mixture strength (e.g., 100/0, 75/25, etc.)

• Station (e.g., BAK, etc.)

• Date sample was taken

5. COMMUNICATIONS

5.1 Communication Procedures

Persons communicating with the flight crew shall have a basic knowledge of the English language (operational level or equivalent according to the current version of the Training Document AS6286). For local flights involving local flight and ground crews, local language may be used by them (see the current version of training document AS6286).

Communication between the flight crew and the deicing crew will usually be achieved using a combination of printed forms and verbal communication. For treatments carried out after aircraft doors are closed, the use of flight interphone (headset) or VHF radio will usually be required. Electronic message boards may also be used in ‘off stand’ situations. Use of hand signals is not recommended except for the final ‘all clear’ signal.

NOTE: No flight crew communication is required and no holdover time applies if the aircraft is deiced using Type I for overnight frost in the absence of further precipitation or active frost.

5.2 Communication Prior to Starting Deicing/Anti-Icing Treatment

a. Before starting deicing/anti-icing, the flight crew shall be requested to confirm the treatment required (i.e., surfaces and components to be de-iced, anti-icing requirements, plus any special deicing procedures).

b. Before fluid treatment starts, the flight crew shall be requested to configure the aircraft for deicing/anti-icing (surfaces, controls, and systems as per aircraft type requirements or recommended procedures). The deicing crew shall wait for confirmation that this has been completed before commencing the treatment.

c. For treatments conducted without the flight crew present, suitably Qualified Staff shall be nominated by the aircraft operator to confirm the treatment required (when applicable) and to confirm the correct configuration of the aircraft.
5.3 Post Deicing/Anti-Icing Communication

An aircraft shall not be dispatched for departure after a deicing/anti-icing operation until the flight crew has been notified of the type of deicing/anti-icing operation performed (i.e., the Anti-Icing Code). The Anti-Icing Code (see 5.4) shall be provided by Qualified Staff upon completion of the treatment, indicating that the checked surfaces (see section 7.3) are free of frost, snow, slush, or ice; that deicing/anti-icing is complete, that equipment is cleared from the area; and in addition, providing the necessary information for the flight crew to estimate the appropriate holdover time for the prevailing weather conditions when anti-icing fluid has been used. When a treatment is interrupted for a significant period of time (e.g., truck runs out of fluid) the flight crew shall be informed stating the reason, the action to be taken and the estimated time delay. When continuing the treatment, the previously treated surfaces must be fully de-iced and anti-iced again, when the holdover time of the treatment from before the interruption is not sufficient.

5.4 The Anti-Icing Code

The following elements comprising the Anti-Icing Code shall be recorded and be communicated to the flight crew by referring to the final step of the fluid deicing/anti-icing treatment procedure; it shall be provided in the sequence given below:

NOTE: This information shall not be communicated in circumstances where anti-icing holdover times do not apply, e.g., local frost prevention in cold-soaked wing areas, symmetrical local area deicing, or deicing of specific surfaces only (such as leading edges for removal of impact ice), etc. In these circumstances, upon completion of the treatment, the flight crew shall be provided with the deicing fluid type applied (e.g., "Type I"); a statement that holdover time does not apply (e.g., "no holdover time applies"); and confirmation that the post-deicing check has been completed (e.g., "post deicing check completed").

a. The fluid type (i.e., Type I, II, III, or IV);

b. The fluid name (manufacturer and brand/trade name) of the Type II, III, or IV anti-icing fluid, if applicable;

   NOTE: Communication of this element is not required for Type I fluid.

c. The concentration of fluid (dilution) within the neat fluid/water mixture, expressed as a percentage by volume for Type II, III, or IV (i.e., 100% ("neat") = 100% fluid, 75% = 75% fluid and 25% water, 50% = 50% fluid and 50% water);

   NOTE: Communication of this element is not required for Type I fluid.

d. The local time (hours and minutes), either:

   • For a one-step deicing/anti-icing operation: at the start of the final treatment; or
   • For a two-step deicing/anti-icing operation: at the start of the second step (anti-icing);

e. The date in the following format: day, month, year (DDMMMYY (e.g., 28JAN15 = January 28, 2015));

   NOTE: This element is required for record keeping and is optional for flight crew notification.

f. The statement, “Post-deicing/anti-icing check completed.”

   NOTE: For specific aircraft types, additional requirements exist, e.g., tactile checks for clear ice on wing surfaces. Additional confirmation for these checks may be required.

EXAMPLE:

The last step of a deicing/anti-icing procedure is the application of a mixture of 75% Type II fluid and 25% water, made by the Manufacturer as Brand X, commencing at 13:35 local time on 20 February 2016, is reported and recorded as follows:
5.5 Post-Deicing/Anti-Icing Check and Transmission of the Anti-Icing Code to the Flight Crew

It shall be clearly defined by the aircraft operator which company is responsible for conducting the post-deicing/anti-icing check and providing the flight crew with the Anti-Icing Code. If two different companies are involved in the deicing/anti-icing treatment and post-deicing/anti-icing check, it must be ensured that the Anti-Icing Code is not given before the post-deicing/anti-icing check has been completed.

The company conducting the deicing/anti-icing treatment shall be responsible for the treatment and transmit all information about the treatment to the company conducting the post-deicing/anti-icing check. The company conducting the post-deicing/anti-icing check shall have overall responsibility for the performance of the company conducting the deicing/anti-icing treatment.

5.6 All Clear Signal

The flight crew shall receive a confirmation from the ground crew that all deicing/anti-icing operations are complete and that all personnel and equipment have been removed from the area before reconfiguring or moving the aircraft.

5.7 Off-Gate Communications

During deicing/anti-icing, a two-way communication between the flight crew and the deicing/anti-icing operator/supervisor must be established prior to the deicing/anti-icing treatment. This may be done either by interphone or by VHF radio. Alternate means of communication may be the use of ACARS, EFBs, and EMBs. In the event of conflict, verbal communication shall take precedence.

During treatment, all necessary information must be transmitted to the flight crew, including the beginning of treatment, treatment of the sections requiring de-activation of aircraft systems, the Anti-Icing Code, etc., (using standardized deicing/anti-icing phraseology). Communication contact with the flight crew may be concluded after transmission of the Anti-Icing Code and readiness for taxi-out has been announced. During deicing/anti-icing operations with engines running, both verbal and visual communications shall be utilized and positive control maintained during the deicing/anti-icing operation in accordance with ARP5660.

a. General instructions: The deicing/anti-icing operator and/or airport authority must ensure that all necessary information regarding operation of the off-gate/CDF/DDF site is published and available to flight crews. This information shall be included within the deicing/anti-icing operator’s and/or airport authority’s local procedures documentation and be made available to air operators and flight crews (e.g., it can be included as part of flight release documentation, etc.). This information should also be published in applicable state aeronautical navigation documents/publications. This information shall include, at a minimum:

- The location of and standard taxi routing to, within, and from the deicing/anti-icing site;
- The means by which to coordinate the deicing/anti-icing operation;
- The means by which to communicate before, during, and after the deicing/anti-icing operation;
- The means by which taxi-and-stop guidance is provided to the flight crew (e.g., VHF, EMB’s, etc.); and,
- Any unique requirements or procedural differences affecting the flight crew and/or flight crew/ground crew interface.
b. Responsibilities: The responsibility to conduct a Contamination Check before dispatch rests with trained and qualified personnel. The results of the Contamination Check must be provided to the flight crew via verbal or visual (written or electronic) means. Subsequently, the flight crew is responsible for acquiring the proper treatment. After treatment, the treated surfaces and components must be checked by a trained and Qualified Staff (see Section 11) and the Anti-Icing Code must be given to the flight crew (see 5.4). Subsequently, the flight crew is responsible for the airworthiness of the aircraft.

c. Emergency procedures: Whether conducting deicing/anti-icing operations at a remote location or at a centralized deicing/anti-icing facility, local procedures shall be established to ensure that both aircraft and ground emergencies are handled safely, expeditiously, and are coordinated with the local emergency plan.

5.8 Scripts

Following standard communication terminology is recommended during off-gate deicing/anti-icing procedures:

- (DIS = Deicing/anti-icing supervisor)
- (COMMANDER = Pilot in command)

DIS: “Set parking-brake, confirm the airplane is ready for treatment, inform on any special requests.”

After the airplane is configured for treatment:

COMMANDER: “Parking brake rakes is set, you may begin treatment and observe...(any special requests like: ice under wing/flaps, clear-ice on top of wing, snow on fuselage, ice on landing-gear, anti-ice with Type IV fluid, etc.)”.

DIS: “The treatment will begin now...(special request given, like “ice under wing”, etc.) I will call you back when ready”.

Only after all equipment is cleared from the airplane and all checks are completed:

DIS: “Deicing/anti-icing completed, Anti-icing Code is: …….. (plus any additional info needed). I am disconnecting. Standby for clear signal at right/left and/or contact ground/tower for taxi clearance.”

COMMANDER: “Deicing/anti-icing completed, Anti-icing code is ……..”

5.9 Phraseology

Guidelines for establishing clear concise standardized communication and phraseology between aircraft flight and ground crews during aircraft deicing operations is contained in ARP6257. It is very important that both parties communicate fully about contact requirements, aircraft configuration, de/anti-icing treatment needed, and post deicing reporting requirements.

5.10 Communication for Proximity Sensor Activation by Physical Contact

For equipment types furnished with a proximity sensor requiring physical contact in order to activate (refer to 8.7.19 for further information), and, in the event of sensor contact, the Pilot in Command shall be informed using the following phraseology:

Ground Crew to Flight Crew:

“A safety proximity sensor (identify location on the deicing equipment) has been activated on the (specify specific location on the aircraft). (Name third party title that performed inspection) has performed a visual inspection on the affected area. Provide results of the third party inspection (e.g., there is no visual damage detected or damage is suspected or present). Advise your intentions.”
6. AIRCRAFT REQUIREMENTS AFTER DEICING/ANTI-ICING

Following the deicing/anti-icing procedures and prior to takeoff, the critical aircraft surfaces shall be free of all frost, snow, slush, or ice accumulations in accordance with the following requirements.

6.1 Wings, Tails, and Control Surfaces

Wings, tails, and control surfaces shall be free of frost, snow, slush, or ice unless the aircraft manufacturer and state regulatory authority permits that a coating of frost may be present on wing lower surfaces in areas cold soaked by fuel between forward and aft spars; and/or on upper wing surfaces within defined areas, in accordance with the aircraft manufacturer’s published documentation.

NOTE: Except for frost due to cold-soaked fuel as mentioned above, and unless otherwise specified in the Aircraft Flight Manual or other aircraft manufacturer's documentation, contamination is not acceptable on: the upper or lower surfaces of the horizontal stabilizer and elevator/tab; strakes; inboard, outboard, upper, and lower surfaces of the wing and wing tip devices; and either side of the vertical stabilizer and rudder.

6.2 Pitot Tubes, Static Ports, and All Other Air Data Sensing Devices

Pitot tubes, static ports, and other air data sensing devices shall be free of frost, snow, slush, ice, and fluid.

6.3 Engines

Engine inlets (including the leading edge), exhaust, cooling intakes, control system probes, and ports shall be free of frost, snow, slush, or ice. Engine fan blades, propellers (as appropriate), and spinner cones shall be free of frost, snow, slush, or ice, and shall be free to rotate.

6.4 Air Conditioning Inlets and Outlets

Air inlets, outlets, pressure-release valves, and outflow valves shall be free of frost, snow, slush, or ice, and shall be unobstructed.

6.5 Landing Gear and Landing Gear Doors

Landing gear and landing gear doors shall be unobstructed and free of frost, snow, slush, or ice. Do not spray deicing/anti-icing fluids directly onto wiring harnesses and electrical components (receptacles, junction boxes, etc.,) brakes, wheels, exhausts, or thrust reversers.

6.6 Fuel Tank Vents

Fuel tank vents shall be free of frost, snow, slush, or ice.

6.7 Fuselage

The fuselage shall be free of ice, slush, and snow. In accordance with the aircraft manufacturer's documentation, frost may be present on the fuselage for take-off within specified amounts provided that no other forms of contamination are present, and inlets, outlets, and other devices (as identified by the aircraft manufacturer) are free of contamination.

6.8 Flight Deck Windows and Nose or Radome Area

Any significant deposits of frost, snow, slush, or ice on the windscreens or on areas forward of the windscreens shall be removed prior to departure. Heated flight deck windows will not normally require deicing. Any forward area from which fluid may flow back onto windscreens during taxi or subsequent takeoff shall be free of fluid prior to departure.
If SAE Type II, III, or IV fluid has been used, all traces of the fluid on flight deck windows shall be removed prior to departure, with particular attention paid to windows fitted with wipers. Thickened-fluid (SAE Type II, III, or IV) can be removed by using a diluted Type I mixture, water (where it has been determined that refreezing will not occur), a manual method (ensuring that windscreen heat is turned off), or another cleaner as approved by the aircraft manufacturer.

NOTE: During falling precipitation, heated windows may cause liquid runoff to freeze near sensors, requiring deicing.

6.9 Dried Thickened Fluid Residues When the Aircraft Has Not Been Flown After Anti-Icing

Dried thickened-fluid (SAE Type II, III, or IV) residues can occur when surfaces have been deiced/anti-iced but the aircraft has not imminently been flown and has not been subject to precipitation. The fluid may then have dried on the surfaces. In such situations, the aircraft must be checked for dried residues from thickened fluids and cleaned as necessary.

6.10 Special Maintenance Considerations

Proper account should be taken of the possible side-effects of fluid use. Such effects may include, but are not necessarily limited to, dried and/or rehydrated residues and the removal of lubricants.

7. CHECKS

The decision that deicing/anti-icing is required may be determined when one or more of the following circumstances is applicable:

- An aircraft is parked overnight and subjected to ice or snow conditions
- When ice has accumulated in flight (inflight ice)
- During taxi to the gate occurring in icing and/or snow conditions
- Following an inspection or check by the flight crew at a gate
- As indicated by a check by a qualified deicing/anti-icing person
- Active frozen or freezing falling precipitation is occurring
- When cold soaked fuel has created ice or frost on critical surfaces or components
- When aircraft has been deiced/anti-iced some time prior to flight crew arrival

7.1 Contamination Check to Establish the Need for Deicing

A Contamination Check shall include all areas mentioned in 6.1 through 6.8 and any other surfaces and components of the aircraft as indicated by the aircraft manufacturer and shall be performed from points offering sufficient visibility of these parts (e.g., from the deicing/anti-icing vehicle, a ladder or any other suitable means of access as necessary). Any contamination found on the surfaces or components of the aircraft that are critical to safe flight shall be removed by a deicing treatment; this shall be followed by anti-icing treatment when required.

Where an aircraft has been de-iced and/or anti-iced some time prior to the arrival of the flight crew, an additional 'Contamination Check' shall be carried out prior to departure, in order to establish whether further treatment is required. Requests for deicing/anti-icing shall specify the parts of the aeroplane requiring treatment.

NOTE: For specific aeroplane types additional requirements exist e.g., special clear ice checks, such as tactile checks on wings. These special checks are not covered by the contamination check. Aeroplane operators shall make arrangements for suitably qualified personnel to meet these requirements.
7.2 Tactile Check

The need for a tactile check shall be determined by the aircraft manufacturer.

7.3 Post Deicing/Anti-Icing Check

An aircraft shall not be dispatched after a deicing/anti-icing treatment until the aircraft has received the following visual check by Qualified Staff. This check shall include wings, horizontal stabilizers (both lower and upper surfaces), vertical stabilizer, and fuselage, including pitot heads, static ports temperature and angle of attack sensors. This check shall also include any other parts of the aircraft on which a deicing/anti-icing treatment was performed according to the requirements identified during the contamination check.

The post deicing/anti-icing check shall be performed from points offering sufficient visibility of all treated surfaces (e.g., from a deicing/anti-icing vehicle, ladder, or other suitable means of access). Any contamination found shall be removed by further deicing/anti-icing treatment, and the post deicing/anti-icing check shall be repeated. Before takeoff, the flight crew must ensure that they have received confirmation that this post deicing/anti-icing check has been accomplished.

NOTE: For specific aircraft types, additional requirements exist, e.g., special clear-ice checks, such as tactile checks on wings. These special checks are not covered by the Post Deicing/Anti-icing Check. Aircraft operators shall make arrangements for suitably Qualified Staff to meet any special check requirements.

When the deicing/anti-icing service provider performs the deicing/anti-icing treatment as well as the Post Deicing/Anti-icing Check, it may either be performed as a separate check or incorporated into the deicing/anti-icing operation as specified below. The deicing/anti-icing service provider shall specify the method used in his winter procedures, by customer where necessary:

a. As the deicing/anti-icing treatment progresses, the deicing/anti-icing sprayer will closely monitor the surfaces receiving treatment in order to ensure that all forms of frost, snow, slush, or ice (with the exception of cold-soaked fuel frost on the lower surface of wings and light frost on the fuselage, which may be allowed per the aircraft manufacturer and state regulatory authority) are removed and that upon completion of anti-icing treatment, these surfaces are fully covered with an adequate layer of anti-icing fluid.

b. When the request for deicing/anti-icing did not specify the fuselage, a visual check of the fuselage shall be performed at this time, in order to confirm that it has remained free of contamination (with the possible exception of light frost, which may be allowed as per the aircraft manufacturer and state regulatory authority).

c. Any evidence of contamination that is outside the defined limits shall be reported to the flight crew immediately and be removed by further deicing/anti-icing treatment. Then the post deicing/anti-icing check shall be repeated.

d. Once the treatment has been completed, the Deicing Operator will conduct a close visual check of the surface where the treatment commenced, in order to ensure that it has remained free of contamination (this check is not required for ‘frost only’ conditions).

7.4 Pre Takeoff Check

The flight crew shall continually monitor the weather conditions after the deicing/anti-icing treatment. Prior to takeoff a flight crew member shall assess whether the applied holdover time is still appropriate and/or if untreated surfaces may have become contaminated. This check is normally performed from inside the flight deck.

7.5 Pre Takeoff Contamination Check

This is a check of the critical surfaces for contamination. This check shall be performed when the condition of the critical surfaces of the aircraft cannot be effectively assessed by a pre-takeoff check or when the holdover time has been exceeded. This check is normally performed outside of the aircraft. The alternate means of compliance for a pre-takeoff contamination check is to perform a complete deicing/anti-icing re-treatment of the aircraft.
7.6 Flight Control Check

A functional flight control check using an external observer may be required after deicing/anti-icing depending upon aeroplane type (see relevant manuals). This is particularly important in the case of an aeroplane that has been subjected to an extreme ice or snow covering.

8. AIRCRAFT GROUND DEICING/ANTI-ICING METHODS

8.1 Aircraft Ground Deicing/Anti-Icing Methods, General Comments

These procedures specify the methods for deicing and anti-icing of aircraft on the ground to provide safe takeoff. When aircraft surfaces are contaminated by frozen moisture, they shall be deiced prior to dispatch with fluids, mechanical methods, alternative technologies, or combinations thereof. When freezing precipitation exists and the precipitation is adhering to the surfaces at the time of dispatch, aircraft surfaces shall be deiced/anti-iced with fluids. If both deicing and anti-icing are required, the procedure may be performed in one or two steps. The selection of a one- or two-step process depends upon weather conditions, available equipment, available methods (generally the use of deicing and anti-icing fluids), and the holdover time needed. If a one-step procedure is used, then both 8.4 and 8.5 apply for guidance regarding fluid limitations.

CAUTION: Slippery conditions can exist on the ground or equipment following the deicing/anti-icing treatment.

8.2 Pre-Deicing Process to Be Done Prior to Deicing/Anti-Icing

Companies may employ a pre-deicing process prior to the main deicing process, in order to remove large amounts of frozen contamination (e.g., snow, slush, or ice), in order to reduce the quantity of glycol-based deicing fluid that is needed. This pre-deicing process may be performed with various means (e.g., infrared technology, brooms, forced air, fluid injected into forced air, heat, heated water, heated fluids with negative buffer). If the pre-step process is used, make sure that the subsequent deicing process removes all frozen contamination including the contamination that may have formed on surfaces and/or in cavities due to the pre-step process.

8.3 Infrared Deicing

This sub-section establishes the procedures for the removal of frozen precipitation by using infrared deicing technology. Specific information on facility requirements, as well as their inclusion in aircraft ground deicing programs, can be found in publications listed in Section 2 of this document.

a. General requirements: Frost, snow, slush, or ice shall be removed from aircraft surfaces prior to dispatch from the facility or prior to anti-icing.

b. Deicing: Deicing using infrared energy is accomplished through heat that breaks the bond of adhering frozen contamination. The application of infrared energy may be continued to melt and evaporate frozen contaminants. Wet surfaces require an application of heated deicing fluids to preclude refreezing after removal of infrared energy source. When required, for operations other than frost or leading edge ice removal and when OAT is at or below 0 °C (32 °F), an additional treatment with hot deicing fluid shall be performed within the facility to prevent re-freezing of water which may remain in hidden areas.

CAUTION: If the aircraft requires re-deicing and de/anti-icing fluids had been applied before flight, conventional de/anti-icing with fluids shall be performed.

c. Inspection: The aircraft shall be inspected in accordance with the requirements of Section 6.

d. Anti-icing: If anti-icing is required, it shall be accomplished in accordance with 8.7.2. If anti-icing is performed inside the facility, infrared power levels must be adjusted as required during the anti-icing process to prevent the re-accumulation of frozen contamination due to the effect of snow blowing through the facility and to maintain fluid integrity for the time the aircraft is in the facility. Dehydration of the fluid can negatively impact the fluid performance.
8.4 Deicing by Fluids

Frost, snow, slush, or ice may be removed from aircraft surfaces by the use of deicing fluids. It is the responsibility of the Deicing Service Provider to ensure that all frozen deposits (with the possible exception of frost which may be allowed as described in Section 6) are removed from the specified surfaces during the deicing process.

CAUTION: Consult aircraft maintenance manuals for limitations for the maximum application pressure and temperature.

8.4.1 Removal of Contaminants

For maximum effect, fluids shall be applied close to the surface to minimise heat loss. Fluid temperature and pressure should not exceed aircraft maintenance manual requirements. The heat in the fluid effectively melts any frost, as well as light deposits of snow, slush, and ice. Heavier accumulations require the heat to break the bond between the frozen deposits and the structure; the hydraulic force of the fluid spray is then used to flush off the contamination. The deicing fluid will prevent re-freezing for a period of time depending on aircraft skin and OAT, the fluid used, the mixture strength, and the weather.

8.4.2 Removal of Frost and Light Ice

A general procedure consisting of a nozzle setting that gives a solid cone (fan) spray should be used. This ensures the largest droplet pattern available, thus retaining the maximum heat in the fluid. Providing the hot fluid is applied close to the aircraft skin, a minimal amount of fluid will be required to melt the deposit.

8.4.3 Removal of Snow

A nozzle setting sufficient to flush off deposits and minimise foam production is recommended. Foam could be confused as snow. The method adopted will depend on the equipment available and the depth and type of snow; i.e., light and dry or wet and heavy. In general, the heavier the deposits of snow or ice, the heavier the fluid flow that will be required to remove it effectively and efficiently from the aircraft surfaces. For light deposits of both wet and dry snow, similar procedures as for frost removal may be adopted.

Wet snow is more difficult to remove than dry snow and unless deposits are relatively light, the selection of a high fluid flow will be found to be more effective. Under certain conditions it will be possible to use the heat, combined with the hydraulic force of the fluid spray, to melt and subsequently flush off frozen deposits. However, where snow has bonded to the aircraft skin, the procedures detailed in 8.4.4 should be utilised. Heavy accumulation of snow will always be difficult to remove from aircraft surfaces and vast quantities of fluid will invariably be consumed in the attempt. Under these conditions, serious consideration should be given to removing the majority of the snow using a pre-step process before attempting a normal deicing process.

8.4.4 Removal of Ice

Heated fluid shall be used to break the ice bond. The high thermal conductivity of metal skin is utilized when a stream of hot fluid is directed at close range onto one spot, until the surface is just exposed. This will then transmit the heat laterally in all directions raising the temperature above the freeze point and thereby breaking the adhesion of the frozen mass with the aircraft surface.

Non-metallic surfaces (e.g., composites) have a lower heat transfer than metallic surfaces. Deicing may take longer and more fluid may be needed. By repeating this procedure a number of times the adhesion of a large area of frozen snow or glazed ice can be broken. The deposits can then be flushed off with either a low or high flow, depending on the amount of the deposit.

8.4.5 General Deicing Fluid Application Strategy

For effective removal of snow and ice the following techniques should be adopted. Aircraft may require unique procedures to accommodate design differences, aircraft manufacturer's instructions should be consulted. Ice, snow, or frost dilutes the fluid. Apply enough hot deicing fluid to ensure that re-freezing does not occur and all contaminated fluid is driven off. The application of deicing fluid must be done in a pattern that ensures all contaminants on the aircraft are removed. The preferred method is to spray the aircraft from top to bottom.
8.4.6 Wings, Horizontal Stabilizers, and Elevators

The direction of the spray shall be from the leading edge to the trailing edge.

NOTE: There is an exception: On aircraft with no leading edge devices (i.e., hard wing and/or propeller driven), deicing/anti-icing fluid may be sprayed from highest point of the wing surface camber to the lowest, flowing forward over the leading edge of the wing ensuring sufficient rollover, and over the trailing edge. Caution must be used to ensure fluid is not sprayed directly into any wing openings.

8.4.7 Lower Wing Surface (under side of wing) Deicing Procedures

Treatments must be symmetrical and may include flaps and lower surfaces. Spray the affected areas with a heated fluid/water mixture suitable for a one-step procedure as required, (see caution below), and then spray the same areas under the other wing. Both wings must be treated identically (same areas, same amount and type of fluid, same mixture strength), even if the frozen contamination is only present under one wing. Holdover times do not apply to underwing treatments.

It is the responsibility of the Deicing Service Provider to ensure that the treatment is performed symmetrically and that on completion all frozen deposits (with the possible exception of frost, which may be allowed), have been removed. When it is confirmed that the treated areas are clean, the following statement shall be given to the flight crew: “Underwing deicing only, holdover times do not apply”

CAUTION: Underwing frost and ice are usually caused by very cold fuel in the wing tanks. Use a fluid/water mixture with a higher concentration of glycol than is usually required by the OAT to prevent re-freezing.

8.4.8 Removal of Local Area Contamination

When no precipitation is falling or expected, and when there is no active frost a “local area” deicing may be carried out under the below mentioned or similar conditions. In some cases a full or complete deicing is not necessary. When the presence of frost and/or ice is limited to localised areas on the surfaces of the aircraft and no holdover time is applicable, only the contaminated areas will require treatment.

This type of contamination will generally be found on the wing and/or stabilizer leading edges or in patches on the wing and/or stabilizer upper surfaces. Spray the affected area(s) with a heated fluid/water mixture suitable for a one-step procedure. Both sides of the wing and/or stabilizer upper surfaces shall receive the same amount and type of fluid at the same concentration; the same area in the same location on each wing/stabilizer shall be sprayed including when conditions would not indicate the need for treatment of both wings/stabilizers.

It is the responsibility of the Deicing Service Provider to ensure that the treatment is performed symmetrically and that on completion all frozen deposits have been removed. After this check has confirmed that the areas are clean the following statement shall be given to the flight crew: “Local area deicing only. Holdover times do not apply”

8.4.9 Vertical Surfaces

Start at the top and work down to the base of any vertical surfaces.

8.4.10 Fuselage

Spray the fluid along the top centerline and then towards the outboard of the fuselage. Ensure that it is clear of ice, snow, and slush in accordance with the aircraft manufacturers’ manuals. Hoarfrost may be allowed in accordance with the aircraft manufacturers’ manuals.

8.4.11 Nose/Radome Area and Flight Deck Windows

Type I fluid/water mixture or manual methods of removal (such as squeegees or brushes) are recommended.
When thickened fluids are used, avoid spraying near the flight deck windows, as fluid can cause a severe loss of visibility. Any thickened fluid remaining on the nose areas where it could blow back onto the windscreens should be removed prior to departure, using a diluted type I fluid, squeegees or equivalent. If flight deck windows are contaminated with thickened fluids use water or an approved windshield cleaner (use of a low windscreen washing fluid is recommended when OAT is at or below 0 °C (32 °F)).

CAUTION: Prior to cleaning of the flight deck windows ensure that the window heating system is switched off.

8.4.12 Landing Gear and Wheel Bays

Do not spray deicing fluid directly onto wheels and brakes. Remove all ice and snow from the landing gear; paying particular attention to uplocks, downlocks, sensors, door mechanisms, and steering systems.

NOTE: It may be possible to mechanically remove accumulations such as blown snow, however, where deposits have bonded to surfaces they can be removed by the application of hot air.

8.4.13 Engines

Deposits of snow should be mechanically removed from engines prior to departure. Any frozen deposits that may have bonded to either the lower surface of the intake or the fan blades including the rear side, or propellers, may be removed by hot air or other means recommended by the engine manufacturer. If use of deicing fluid is permitted, do not spray directly into the engine core.

8.5 Anti-Icing by Fluids

Frost, snow, slush, or ice will, for a period of time, be prevented from adhering to or accumulating on aircraft surfaces by the application of anti-icing fluids. This section provides procedures for the use of anti-icing fluids.

a. Required Usage: Anti-icing fluid shall be applied to the aircraft surfaces when freezing rain, snow, or other freezing precipitation may adhere to the aircraft at the time of dispatch.

b. Optional Usage: Anti-icing fluid may be applied to clean aircraft surfaces at the time of arrival (preferably before unloading begins) on short turnarounds during freezing precipitation, and on overnight aircraft. This will minimize ice accumulation prior to departure and often makes subsequent deicing easier.

CAUTION: This practice has the potential to build up dried residues. An appropriate inspection and cleaning program shall be established.

In anticipation of weather conditions that require deicing, anti-icing fluid may be applied to clean aircraft surfaces prior to aircraft being exposed to the freezing precipitation. This will minimize the possibility of snow and ice bonding or reduce the accumulation of frozen precipitation on aircraft surfaces and facilitate subsequent deicing.

CAUTION: Acetate- or formate-based fluids when used for aircraft deicing may significantly shorten the Holdover Times of Type II, III, and IV fluids when used thereafter, and may also cause corrosion of aircraft materials.

Prior to flight, the aircraft must be deiced, unless the integrity of the fluid can be ensured. Deice in accordance with 8.8, Table 1, whenever possible, to reduce the potential for dried residue build up.

NOTE: Dehydration water evaporation of Type II, III, and IV fluid can negatively impact the fluid performance.

For effective anti-icing an even layer of sufficient thickness of fluid is required over the prescribed aircraft surfaces which are free of frozen deposits. For maximum anti-icing protection, undiluted SAE Type II, III, or IV fluid should be used. The high fluid flow pressure and flow rates normally associated with deicing are not required. When possible, pump speeds and nozzle spray patterns should be adjusted accordingly.

NOTE: SAE Type I fluids provide limited holdover effectiveness when used for anti-icing purposes.
8.5.1 Anti-Icing Fluid Application Strategy

The process should be continuous and as short as possible. Anti-icing should be carried out as near to the departure time as possible in order to utilize available holdover time. The anti-icing fluid shall be distributed uniformly and with sufficient thickness over all surfaces to which it is applied. In order to control the uniformity, all aircraft surfaces shall be visually checked during application of the fluid. For a Type I fluid, a minimum of 1 litre/square metre shall be used, with a nozzle temperature of at least 60 °C (140 °F). For Type II, III, or IV fluids which flow readily over surfaces, the correct amount is indicated by fluid just beginning to run off the leading and trailing edges. For fluids which form a more static layer, the minimum quantity required will typically be 1 litre/square metre applied in an even layer across the surface. For further guidance on the amount of fluid, refer to AS6286 training documentation and/or the fluid manufacturer's documentation. Spray from the leading edge to the trailing edge on wings, horizontal and vertical stabilisers. The following surfaces shall be treated as specified by the aircraft manufacturer's documentation:

- Wing upper surfaces including leading edges and upper control surfaces

- Wing tip devices

- Both sides of vertical stabilizer and rudder to receive anti-ice protection when freezing precipitation conditions exist

- Horizontal stabilizer upper surfaces including leading edges and elevator upper surfaces;

- When necessary fuselage upper surfaces dependent upon the amount and type of freezing precipitation (this is especially important on centre-line engine aircrafts).

CAUTION: Anti-icing fluids may not flow evenly over wing leading edges, horizontal and vertical stabilizers. These surfaces should be checked to ensure that they are properly coated with fluid.

It is the responsibility of the Deicing Service Provider to ensure that the surfaces mentioned above are free of frost, snow, slush, or ice prior to the start of the anti-icing treatment and that on completion of the treatment these surfaces are fully covered with an adequate layer of anti-icing fluid.

8.5.2 Local Frost Prevention in Cold Soaked Wing Areas

Wing surface temperatures can be considerably below OAT due to contact with cold fuel and/or close proximity to large masses of cold soaked metal in the wing structure. In these areas frost can build up on wing surfaces and may result in the entire wing needing to be deiced and anti-iced prior to the subsequent departure. This section provides standards for the prevention of local frost formation in cold soaked wing tank areas during transit stops in order to make deicing and anti-icing of the entire wing unnecessary under such circumstances. This procedure does not, however, supersede standard deicing and anti-icing procedures in accordance with 8.4 and 8.5, and it shall be applied in coordination with these subsections. This procedure also does not relieve the user from any requirements for treatment and checks in accordance with aircraft manufacturer manuals.

NOTE: this section is also applicable to other surfaces of the aircraft (e.g., stabilizers)

a. Procedure

Using suitable spray equipment, apply a proper coating of undiluted SAE Type II, III, or IV fluid to the wings in the limited cold soaked areas where the formation of frost may be expected due to contact of the wing with cold fuel or masses of cold metal.

NOTE: A proper coating completely covers the treated area with visible fluid.
b. Limits/Precautions for Local Frost Prevention

- Procedure Limitation: This local frost prevention procedure is not a substitute for standard deicing and anti-icing procedures in accordance with sections 9.4.1 and 9.5.1, clear ice checks or any other aircraft manufacturer requirement, nor a substitute for the requirement that aircraft surfaces shall be clear of frost, snow, slush or ice accumulations.

- Operator Approval: This procedure shall only be carried out if approved by the operator of the aircraft to be treated.

- Training: This procedure shall only be carried out by trained and qualified personnel (reference AS 6286).

c. Application limits

This local frost prevention procedure shall be applied to clean wings immediately following arrival of the aircraft. Application is acceptable at the latest when frost just starts to form, but in this case the fluid shall be applied at a minimum temperature of 50 °C (122 °F). If precipitation occurred between application of the fluid and dispatch of the aircraft and/or if precipitation is expected before takeoff, a two-step deicing/anti-icing procedure shall be performed (refer to 8.4 and 8.5).

d. Symmetrical treatment requirement

Wings shall receive the same and symmetrical treatment; the same area in the same location on each wing shall be sprayed including when conditions would not indicate the need for treatment of both wings.

CAUTION: Aerodynamic problems could result if this requirement is not met.

e. Holdover time

A holdover time shall not be assigned to local frost prevention since this treatment does not cover the entire aircraft or wing surface respectively.

f. Final check - local frost prevention

A tactile (by touch) check of treated areas and a visual check of untreated areas of both wings shall be performed immediately before the aircraft leaves the parking position. These checks are conducted to ensure that both wings are clean and free of frost. The applied anti-icing fluid shall remain in a liquid state and shall show no indication of failure (e.g., color change to white, a loss of gloss, or the presence of ice crystals in the fluid film).

g. Flight crew information - local frost prevention

The following information shall be provided to the flight crew: “Local frost prevention was accomplished, no holdover times applies.”

8.5.3 Holdover Time

Holdover time is obtained by anti-icing fluids remaining on the aircraft surfaces. With a one-step deicing/anti-icing process the holdover time begins at the start of the treatment and with a two-step deicing/anti-icing process at the start of the second step (anti-icing) Holdover time will have effectively run out when frozen deposits start to form/accumulate on treated aircraft surfaces. Due to their properties, Type I fluids form a thin liquid wetting film, which provides limited holdover time, especially in conditions of freezing precipitation. With this type of fluid no additional holdover time would be provided by increasing the concentration of the fluid in the fluid/water mixture. Type II, III, and IV fluids contain a pseudo plastic thickening agent, which enables the fluid to form a thicker liquid wetting film on external aircraft surfaces. This film provides a longer holdover time especially in conditions of freezing precipitation. With this type of fluid, additional holdover time will be provided by increasing the concentration of the fluid/water mixture, with a maximum holdover time available typically from undiluted fluid.
Holdover time guidelines give an indication as to the time frame of protection that could reasonably be expected under conditions of precipitation. However, due to the many variables that can influence holdover time, these times should not be considered as minima or maxima as the actual time of protection may be extended or reduced, depending upon the particular conditions existing at the time. Holdover time guidelines are established and published by the FAA and TC. The responsibility for the application of this data remains with the user.

CAUTION: Heavy precipitation rates or high moisture content, high wind velocity, or jet blast may reduce holdover time below the lowest time stated in the range. Holdover time may also be reduced when aircraft skin temperature is lower than OAT. Therefore, the indicated times should be used only in conjunction with a pre-takeoff check.

CAUTION: Surface coatings are currently available that may be identified as ice phobic or hydrophobic, enhance the appearance of aircraft external surfaces and/or lead to fuel savings. Since these coatings may affect the fluid wetting capability and the resulting fluid thickness of deicing/anti-icing fluids they have the potential to affect holdover time and aerodynamics. For more information see AIR6232 and consult the aircraft manufacturers.

8.6 Limits

8.6.1 Fluid Related Limits

Temperature Limits (see appropriate tables): When performing two-step deicing/anti-icing, the freeze point (FP) of the fluid used for the first step shall be at or below the OAT.

SAE Type I Fluids: The FP of the SAE Type I fluid mixture used for either one-step deicing/anti-icing or as a second step in the two-step operation shall be at least 10 °C (18 °F) below the OAT. In no case shall this temperature be lower than the LOUT.

CAUTION: All Type I fluids supplied as concentrates for dilution with water prior to use shall not be used undiluted. For exceptions refer to fluid manufacturer's documentation.

CAUTION: All Type I fluids have a maximum concentration mix related to the aerodynamic acceptability. Refer to fluid manufacturer's documentation.

SAE Type II, III, and IV Fluids: The freeze point of SAE Type II, III, IV fluids used for either one-step deicing/anti-icing or as the second step in a two-step treatment shall be at least 7 ºC (13 ºF) below OAT and not lower than the aerodynamic acceptability lower limit of the fluid.

NOTE: These fluids shall not be used below -25 °C (-13 °F) in active frost conditions.

Frost, snow, slush, or ice dilutes the fluid. Apply enough hot deicing fluid to ensure that refreezing does not occur and all contaminated fluid is driven off.

8.6.2 Application Limits (see also the Application Tables 1 and 2 in 8.8)

Under no circumstances shall an aircraft that has been anti-iced receive a further coating of anti-icing fluid directly on top of the contaminated film. If an additional treatment is required before flight, a complete deicing/anti-icing shall be performed (see Application Tables 1 and 2). Ensure that any remaining fluid from any previous treatment is flushed off. Anti-icing only is not permitted.

CAUTION: The application of Type II, III, and IV fluid, especially when used in a one-step process or in the first step of a two-step process, may cause fluid to collect in aerodynamically quiet areas, cavities, and gaps which can dry out and leave dried residues. Dried residues may rehydrate and freeze following a period of high humidity and/or rain conditions. This may cause flight control problems. These dried residues may require removal. Consult the aircraft manufacturer with regard to inspection methods and frequency, related maintenance requirements and aircraft washing recommendations.
The application of hot water or heated Type I fluid in the first step of a two-step process will minimize the formation of residues. Dried residues may rehydrate and freeze under certain temperature, high humidity and/or rain conditions and may block or impede critical flight control systems. If a Type II, III, or IV fluid is used in a one-step process or in the first step of a two-step process, then an appropriate inspection and cleaning program shall be established dependent on the operator’s experience and fleet type. Whenever suitable, deice and anti-ice with only Type I to help avoid these residue issues.

Flight control problems associated with frozen or unfrozen residues have been observed to be particularly prevalent when thickened fluids are used to remove frost during a period of dry weather followed by hydration of the dried residues by water from rain, condensation, cleaning, or wet snow in flight.

NOTE: In order to detect dried residues, it may help to spray a water mist onto the affected surfaces. This causes the dried residues to rehydrate and swell into a gel.

NOTE: If removal of contamination is required on the lower side of the wings and the horizontal stabilizer and elevator, deicing/anti-icing fluid shall be applied sparingly to minimise fluid flow into drain holes. Whenever possible, use Type I only. Consult the aircraft manufacturer’s documentation.

8.6.3 Aircraft Related Limits

The application of deicing/anti-icing fluid shall be in accordance with the requirements of the airframe/engine manufacturers and local procedures.

8.7 Procedure Precautions

8.7.1 One-Step Deicing/Anti-Icing

This is performed using heated deicing/anti-icing fluids (see 8.4.1). The correct fluid concentration is chosen with regard to desired holdover time, dictated by OAT and weather conditions (see application Tables 1 and 2). The fluid used to de-ice the aircraft remains on the aircraft surfaces to provide limited anti-ice capability.

CAUTION: Wing skin temperature may differ and in some cases may be lower than OAT. A mix with higher glycol concentration can be used under the latter condition to ensure a sufficient buffer.

CAUTION: The application of Type II, III, or IV fluid, especially when used in a one-step process, may cause fluid to collect in aerodynamically quiet areas, cavities and gaps which can dry out and leave dried residues. Dried residues may rehydrate and freeze following a period of high humidity and/or rain conditions. This may impede flight control systems. These dried residues may require removal. Consult the aircraft manufacturer with regard to inspection methods and frequency, related maintenance requirements and aircraft washing recommendations.

NOTE: If a Type II, III, or IV fluid is used in a one-step process, then an appropriate inspection and cleaning program shall be established. Whenever suitable, de-ice and anti-ice with only Type I.

NOTE: In order to detect dried residues, it may help to spray a water mist onto the affected surfaces. This causes the dried residues to rehydrate and swell into a gel.

NOTE: If removal of contamination is required on the lower side of the wings and the horizontal stabilizer and elevator, deicing/anti-icing fluid shall be applied sparingly to minimise fluid flow into drain holes. Whenever possible, use Type I only.

Consult the aircraft manufacturer's documentation.
8.7.2 Two-Step Deicing/Anti-Icing when the First Step Is Performed with Deicing Fluid (see 8.5.1)

The correct fluid(s) shall be chosen with regard to OAT (see application Tables 1 and 2). The second step is performed with anti-icing fluid to protect the surfaces. This fluid and its concentration are chosen with regard to desired holdover time, which is dictated by OAT and weather conditions (see application Table 2). The second step shall be performed before the first step fluid freezes if necessary area by area. When treating composite surfaces, freezing may happen quickly. It is the responsibility of the Deicing Service Provider to ensure that all frozen deposits have been removed from the treated surfaces, before applying the second step fluid.

Use a second step spraying technique to cover completely the first step fluid (for example using the method described in 8.5.1) with a sufficient amount of second step fluid. For guidance on the amount of fluid refer to the document AS6286. Where re-freezing occurs following the initial treatment, both the first and second step must be repeated.

CAUTION: Wing skin temperature may differ and in some cases may be lower than OAT. A mix with higher glycol concentration can be used under these conditions to ensure a sufficient buffer.

CAUTION: The application of Type II, III, or IV fluid, especially when used in a one-step process or in the first step of a two-step process, may cause fluid to collect in aerodynamically quiet areas, cavities, and gaps, which can dry out and leave dried residues. Dried residues may rehydrate and freeze following a period of high humidity and/or rain conditions. This may impede flight control systems. These dried residues may require removal. Consult the aircraft manufacturer with regard to inspection methods and frequency, related maintenance requirements and aircraft washing recommendations. The use of hot water or heated mixture of Type I fluid/water for the first step of a two-step deicing/anti-icing process will minimise the formation of dried residues.

NOTE: If a Type II, III, or IV fluid is used in the first step of a two-step process, then an appropriate inspection and cleaning program shall be established. Whenever suitable, de-ice and anti-ice with only Type I.

NOTE: In order to detect dried residues, it may help to spray a water mist onto the affected surfaces. This causes the dried residues to rehydrate and swell into a gel.

NOTE: Anti-icing of the lower side of the wings and/or horizontal stabilizer and elevator is normally not foreseen. However, if these surfaces must be de-iced, the of the deicing fluid must be low enough to prevent refreezing.

8.7.3 With regard to holdover time provided by the applied fluid, the objective is that it is equal to or greater than the estimated time from the start of anti-icing to the start of takeoff based on existing weather conditions.

8.7.4 Aircraft shall be treated symmetrically, that is, left hand and right hand side shall receive the same and complete treatment, even when only one side of the aircraft needs treatment. Anti-icing treatments shall always cover the entire wing, the entire vertical stabilizer/rudder and horizontal stabilizer/elevator on both sides of the aircraft.

WARNING: This is a regulatory requirement. The aircraft is considered UNSAFE if this requirement is not met.

8.7.5 During anti-icing and deicing, the moveable surfaces shall be in a position as specified by the aircraft manufacturer.

8.7.6 Engines shall remain running at idle or can be shut down during deicing/anti-icing operations. Air conditioning and/or APU bleed air shall be selected OFF, or as recommended by the airframe and engine manufacturer. Avoid spraying deicing/anti-icing fluid directly into the engine inlet core.

8.7.7 Do not spray deicing/anti-icing fluids directly onto wiring harnesses and electrical components (receptacles, junction boxes, etc.) brakes, wheels, exhausts, or thrust reversers.

8.7.8 Deicing/anti-icing fluid spray shall not be directed into the orifices of pitot tubes (heads), static ports/vents, or directly onto air stream direction detectors probes/angle of attack airflow sensors. This includes all openings.

8.7.9 All reasonable precautions shall be taken to minimize fluid entry into engines, APU, other intakes/outlets, and control surface cavities. Refer to manufacturer documentation. Deicing/anti-icing fluid spray shall not be directed into engine core or directly onto engine probes/sensors.
8.7.10 Do not direct fluid spray onto the flight deck or cabin windows as this can cause crazing of the acrylic or penetration of the window seals. Fluid spray may be directed above these surfaces and allowed to flow over.

8.7.11 If SAE Type II, III, or IV fluids are used, all traces of the fluid on flight deck windows shall be removed prior to departure, with particular attention being paid to windows fitted with wipers. Any forward area from which fluid may blow back onto windscreens during taxi or subsequent takeoff shall be free of fluid prior to departure. Failure to do so may result in obscured visibility.

NOTE: Deicing/anti-icing fluid can be removed by rinsing with an approved cleaner and a soft cloth or flushing with Type I fluid.

8.7.12 Landing gear and wheel bays shall be kept free from the buildup of slush, ice, or accumulations of blown snow.

8.7.13 When removing ice, snow, or slush from aircraft surfaces care shall be taken to prevent it entering and accumulating in auxiliary intakes and control surface balance bays, gaps, or hinge areas.

8.7.14 Contamination build up on and within aircraft lift devices and other critical surfaces can form in flight or when on the ground. During icing conditions, when flaps and slats are retracted, contamination may not be visible. Conditions where this can occur may include but are not limited to the accumulation of impact ice in flight; the splash up of slush onto the underwing and flaps during ground maneuvering; and flap track contamination where snow and/or other contaminants may blow and compact within these openings. As the possibility exists that this could remain undetected, it is important that when these conditions are present or suspected, these areas be inspected and any frozen deposits removed prior to departure.

8.7.15 Under the conditions of freezing fog, or other freezing precipitation conditions, it is necessary for the front and rear side on the fan blades to be checked for ice buildup prior to start-up. Any deposits discovered are to be removed by directing air from a low flow hot air source, such as a cabin heater, onto the affected areas or other means recommended by the aircraft operator based on information from the aircraft and engine manufacturers.

8.7.16 After frequent applications of deicing/anti-icing fluids it is advisable to inspect aerodynamically quiet areas and cavities for dried residues of thickened deicing/anti-icing fluid. For these inspections it may be necessary to open access panels. Consult airframe manufacturers for inspection and cleaning details and procedures.

8.7.17 A deicing/anti-icing treatment should be continuous and as short as possible. If a treatment is interrupted (for example a truck running out of fluid), the cockpit crew shall be immediately informed stating:

- The reason for the interruption;
- Actions to be taken (in consultation with the cockpit crew);
- Expected time of delay.

Before continuing the treatment:

- Inform the cockpit crew;
- Establish in consultation with the cockpit crew, the further treatment to be carried out, including any surfaces requiring re-treatment in relation to holdover time.

Carry out the treatment as agreed.

8.7.18 Clear Ice Precautions

Clear ice can form on aircraft surfaces below a layer of snow or slush. It is therefore important that surfaces are closely examined following each deicing operation, in order to ensure that all deposits have been removed. Significant deposits of clear ice can form in the vicinity of the fuel tanks, on wing upper surfaces as well as underwing. Aircraft are most vulnerable with regard to this type of buildup when one or more of the following conditions exist:
• Wing temperatures remain well below 0 °C (32 °F) during the turnaround/transit.

• Ambient humidity is high and/or Precipitation occurs while the aircraft is on the ground.

• When frost or ice is present on lower surface of either wing.

• Ambient temperatures between -2 °C (28 °F) and +15 °C (59 °F) are experienced, although clear ice may form at other temperatures if the other three conditions listed above exist.

Clear ice formation is extremely difficult to detect. Therefore, when the above conditions prevail, or when there is otherwise any doubt that clear ice may have formed, a close examination shall be made visually and/or physically prior to departure, in order to ensure that surfaces are free of clear ice. If clear ice is believed to be present, deicing is required.

NOTE: Low wing temperatures associated with this type of buildup normally occur when large quantities of cold fuel remain in wing tanks during the turnaround/transit and any subsequent refueling is insufficient to cause a significant increase in fuel temperature.

8.7.19 Proximity Sensor Activation Reporting Procedures

An operational procedure shall be in place in circumstances where a proximity sensor on the deicing equipment is activated and/or comes into contact with an aircraft surface. For equipment types furnished with a proximity sensor requiring physical contact in order to activate, in the event of sensor contact, the pilot in command shall be informed immediately, and be provided with specific information pertaining to the location on the aircraft where contact was made. The equipment involved shall remain in position until investigation can occur to inspect the affected area for damage.

A third party shall visually inspect the affected area for any signs of visual damage. If no visible damage is observed, the de/anti-icing process may continue at the discretion of the pilot in command. If damage is suspected or detected, the pilot in command shall be notified and the de/anti-icing process shall cease. Further inspection of the affected area should be performed by an individual deemed qualified under the air operators program to determine the aircraft’s airworthiness.

NOTE: By design, this type of proximity sensor normally will not cause damage to an aircraft surface if contact is made to a fixed aircraft surface, while the equipment chassis is stationary. In certain circumstances however, damage may occur outside of the sensors design limitations. This includes but is not limited to:

• Contact with an aircraft surface while the equipment chassis is maneuvering;

• Contact with an aircraft surface while the aircraft is maneuvering;

• Contact with a moving/rotating aircraft surface (i.e. propeller, engine fan blade, etc.); and/or

• Contact is made or suspected to have been made between a component of the deicing vehicle and aircraft.

In these circumstances, the procedures mentioned above this note shall apply. Should a proximity sensor be activated, all pertinent and relevant details shall be documented, including (at a minimum):

• Date

• Time

• Vehicle operator name(s)

• Vehicle identification (e.g., number)

• Flight number

• Aircraft registration and/or air operator fleet identification (e.g., fin/tail/ship number, etc.)
• Deicing location (e.g., bay or gate number)

• Location on the aircraft where the contact was made, including specifics (e.g., side, aircraft part, etc.)

• Proximity sensor location on the vehicle and point where the contact was made (e.g., nozzle, left side of sensor, etc.)

• Name and job title of the third party individual that performed inspection

• Third party company name (not required if third party is from the de/anti-icing company)

• Result of the third party inspection (e.g., no visual damage detected or damage suspected/present).

Ground crew involved in the de/anti-icing operation shall be trained on the operation of the proximity sensor (including equipment reactivation) and procedures in the event of contact. In addition, for those personnel deemed qualified to perform the third party inspection, they shall also be trained on visual inspection requirements and procedures. Flight crew should be trained on the purpose and functionality of a proximity sensor, and the specific company procedures and requirements in the event of contact.

8.8 Fluid Application Tables

**Table 1 - Guidelines for the application of Type I fluid/water mixtures (minimum concentrations) as a function of OAT**

<table>
<thead>
<tr>
<th>OAT</th>
<th>One-Step Procedure</th>
<th>Two-Step Procedure</th>
<th>Second step: Anti-icing (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 °C (32 °F) and above</td>
<td>Heated fluid/water mixture with a freezing point of at least 10 °C (18 °F) below OAT</td>
<td>Heated water or a heated fluid/water mixture</td>
<td>Heated fluid/water mixture with a freezing point of at least 10 °C (18 °F) below OAT</td>
</tr>
<tr>
<td>below 0 °C (32 °F) down to LOUT</td>
<td>Heated fluid/water mixture with a freezing point of at least 10 °C (18 °F) below OAT</td>
<td>Heated fluid/water mixture with a freezing point at OAT or below</td>
<td></td>
</tr>
</tbody>
</table>

(1) To be applied before first step fluid freezes.

**NOTE 1:** Temperature of water or fluid/water mixtures shall be at least 60 °C (140 °F) at the nozzle. Upper temperature limit shall not exceed fluid and aircraft manufacturer's recommendations.

**NOTE 2:** This table is applicable for the use of Type I Holdover Time Guidelines. If holdover times are not required, a temperature of 60 °C (140 °F) at the nozzle is desirable.

**NOTE 3:** To use Type I Holdover Time Guidelines, at least 1 litre/m² (approximately 2 Gals/100ft²) must be applied to the de-iced surfaces.

**CAUTION:** Wing skin temperatures may be lower than OAT. If this condition is identified, a stronger mixture (more glycol) may need to be used to ensure a sufficient buffer.
Table 2 - Guidelines for the application of Type II and Type IV fluid/water mixtures (minimum concentrations) as a function of OAT

<table>
<thead>
<tr>
<th>OAT (1)</th>
<th>Concentration of neat fluid/water mixture in vol%/vol%</th>
<th>One-Step Procedure</th>
<th>Two-Step Procedure</th>
<th>Concentration of neat fluid/water mixture in vol%/vol%</th>
<th>One-Step Procedure</th>
<th>Two-Step Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 °C (32 °F) and above</td>
<td>50/50 Heated (3) Type II or IV fluid/water mixture</td>
<td>Deicing/ Anti-icing</td>
<td>First step: Deicing</td>
<td>Heated water or a heated Type I, II or IV fluid/water mixture</td>
<td>Heated/anti-icing</td>
<td>50/50 Heated/unheated Type II or IV fluid/water mixture</td>
</tr>
<tr>
<td>below 0 °C (32 °F) to -3 °C (27 °F)</td>
<td>50/50 Heated (3) Type II or IV fluid/water mixture</td>
<td>Deicing/ Anti-icing</td>
<td>First step: Deicing</td>
<td>Heated Type I, II or IV fluid/water mixture with a freezing point at OAT or below</td>
<td>Heated/anti-icing</td>
<td>50/50 Heated/unheated Type II or IV fluid/water mixture</td>
</tr>
<tr>
<td>below -3 °C (27 °F) to -14 °C (7 °F)</td>
<td>75/25 Heated (3) Type II or IV fluid/water mixture</td>
<td>Deicing/ Anti-icing</td>
<td>First step: Deicing</td>
<td>Heated Type I, II or IV fluid/water mixture with a freezing point at OAT or below</td>
<td>Heated/anti-icing</td>
<td>75/25 Heated/unheated Type II or IV fluid/water mixture</td>
</tr>
<tr>
<td>below -14 °C (7 °F) to -23 °C (-9 °F)</td>
<td>100/0 Heated (3) Type II or IV fluid/water mixture</td>
<td>Deicing/ Anti-icing</td>
<td>First step: Deicing</td>
<td>Heated Type I, II or IV fluid/water mixture with a freezing point at OAT or below</td>
<td>Heated/anti-icing</td>
<td>100/0 Heated/unheated Type II or IV fluid/water mixture</td>
</tr>
<tr>
<td>below -23 °C (-9 °F)</td>
<td>Type II /Type IV fluid may be used below -23 °C (-9 °F) provided that the of the fluid is at least 7 °C (13 °F) below OAT and that aerodynamic acceptance criteria are met (LOUT).</td>
<td>Deicing/ Anti-icing</td>
<td>First step: Deicing</td>
<td>Type II or IV fluid/water mixture</td>
<td>Heated/anti-icing</td>
<td>Type II or IV fluid/water mixture</td>
</tr>
</tbody>
</table>

**NOTE:** Type III fluid has been removed from this table since the application of the current Type III fluids is fluid specific and does not fit this table.

(1) Fluids must only be used at temperatures above their LOUT.

(2) To be applied before first step fluid freezes.

(3) Clean aeroplanes may be anti-iced with unheated fluid.

**NOTE:** For heated fluid and fluid mixtures, a temperature not less than 60 °C (140 °F) at the nozzle is desirable. When the first step is performed using a fluid/water mixture with a freezing point at OAT, the temperature at the nozzle shall be at least 60 °C (140 °F) and at least 1 litre/m² (~2 Gals/100 ft²) must be applied to the surfaces to be de-iced. Upper temperature limit shall not exceed fluid and aircraft manufacturer's recommendations.

**CAUTION:** Wing skin temperatures may be lower than OAT. If this condition is identified, it shall be verified if a stronger mixture (more glycol) may need to be used to ensure a sufficient buffer. As fluid freezing may occur, 50/50 Type II, III, or IV fluid shall not be used for the anti-icing step of a cold soaked wing as indicated by frost or ice on the lower surface of the wing in the area of the fuel tank.

**CAUTION:** An insufficient amount of anti-icing fluid, especially in the second step of a two step procedure, may cause a substantial loss of holdover time. This is particularly true when using a Type I fluid mixture for the first step (deicing).

**CAUTION:** Some fluids shall only be used undiluted. For some fluids the LOUT may differ. For details refer to fluid manufacturer's documentation.

**NOTE:** Type III fluid has been removed from this table since the application of the current Type III fluids is fluid specific and does not fit this table.
9. GROUND EQUIPMENT

9.1 Deicing Units

Combustion heaters and trucks shall not be operated in confined or poorly ventilated areas to prevent asphyxiation. Requirements for suitable equipment are described in ARP1971.

- Motorized/trucks (see ARP1971 + ARP5058)
- Non-motorized (tower/gantry/carts)
- Forced air or forced air/fluid equipment for the removal of frozen contaminants (see AIR6284)

9.2 Ice Detection Equipment (see AS5116 and AS5681)

10. FLUIDS

10.1 Fluid Storage and Handling

Deicing/anti-icing fluid is a chemical product with an environmental impact. During fluid handling avoid any unnecessary spillage, comply with local environmental and health laws and the manufacturer’s safety data sheet (SDS). Different products shall not be mixed without additional qualification testing. Consult with the fluid manufacturers. Slippery conditions may exist on the ground or equipment following the deicing/anti-icing procedure. Caution should be exercised, particularly under low humidity or non-precipitation weather conditions.

Tanks shall be dedicated to the storage of the deicing and/or anti-icing fluid to avoid contamination with other fluids. Storage tanks shall be constructed of materials compatible with the deicing/anti-icing fluid, as specified by the fluid manufacturer. Care should be taken to avoid using dissimilar metals in contact with each other, as galvanic corrosion may form and degrade thickened fluids. Tanks shall be conspicuously labeled to avoid contamination. As a minimum, the following information must be identified:

- Type of fluid SAE I, II, III, or IV
- Fluid Product Name,
- Fluid Concentration or mixture
- e.g., SAE TYPE I Fluid Manufacturer, Product Name, Concentrate Aircraft Deicing Fluid
- e.g., SAE TYPE I Fluid Manufacturer, Product Name, Dilute Aircraft Deicing Fluid
- e.g., SAE Type IV Fluid Manufacture, Product Name, "undiluted", 75/25 or 50/50

The condition of the tanks shall be examined annually for corrosion, contamination, and/or leaks. If corrosion or contamination is evident, tanks shall be repaired or replaced. Corrosion in tanks most often occurs in the vapor space of partially empty tanks by evaporation and subsequent condensation of water from the deicing fluid. To reduce corrosion, keep tanks containing aircraft deicing fluid full during summer or periods of low use.

NOTE: If the quality of the fluids is checked in accordance with 4.3.2, the tank inspection interval may be longer than one year.

NOTE: Although deicing/anti-icing fluids are generally noncorrosive, their vapor can be corrosive.

Storage temperature limits for the fluid shall comply with the manufacturer’s requirements.
10.2 Fluid Transfer Systems

The performance characteristics of SAE Type II, III, and IV deicing/anti-icing fluids may be degraded by excessive mechanical shearing or chemical contamination. Therefore, only compatible pumps, control valves, piping, hoses, and application devices (nozzles) shall be used. The design of fluid transfer systems shall be in accordance with the fluid manufacturers’ recommendations. Fluid transfer systems shall be dedicated to the specific fluid being handled to prevent inadvertently mixing fluids of different types or manufacturers. All fill ports and discharge points shall be clearly labeled to prevent inadvertent product mixing. All fill ports must be protected to prevent foreign contamination.

10.3 Heating

Deicing/anti-icing fluids shall be heated according to the fluid manufacturer’s guidelines, and the heated fluids shall be checked periodically.

- For Type I fluids, water loss may cause undesirable aerodynamic effects.
- For Type II / III / IV fluids thermal exposure and/or water loss may cause degradation making them not usable.

CAUTION: Avoid unnecessary heating of fluid in vehicle tanks. Prolonged or repeated heating of fluids (directly or indirectly) may result in loss of water or oxidation which can lead to the performance degradation of the fluid, and may cause viscosity degradation in Type II, III, and IV fluids leading to shorter holdover times. Any of the following situations or a combination of them can accelerate the fluid performance degradation:

- Low fluid usage (turnover);
- Trucks being in standby mode with heating system on for extended periods of time;
- High temperatures in the fluid tanks;
- High temperatures in water tanks which are in direct contact with the fluid tanks (no insulation between tanks).

The integrity of the fluid following heating shall be checked periodically. Factors like heating rate, time, and temperature cycling should be considered in determining the frequency of fluid inspections. Refer to the fluid manufacturers’ recommendations.

10.4 Application Equipment

Check with the fluid manufacturer’s recommendations for filling and fluid transitions in order to prevent fluid contamination and degradation. Requirements for suitable equipment are described in ARP1971. Application equipment shall be clean before being initially filled with deicing/anti-icing fluid in order to prevent fluid contamination.

11. STAFF TRAINING AND QUALIFICATION

Deicing/anti-icing procedures must be carried out exclusively by personnel trained and qualified on this subject. Companies providing deicing/anti-icing services shall have both a Qualification Programme and a Quality Control Programme to monitor and maintain an acceptable level of competence.

Training programs shall follow the guidelines and recommendations published in AS6286.
12. NOTES

12.1 Revision Indicator

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.