AEROSPACE STANDARD	AS6285™	REV. E
	Issued 2016-08 Revised 2023-05 Effective 2023-08 Superseding AS6285D	

(R) 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 (Types I, II, III, and IV) and non-fluid methods.

AS6285 forms one part of three related SAE Aerospace Standards (AS) and should be read in conjunction with AS6286 and AS6332. Collectively, AS6285, AS6286, and AS6332 are known to the international community as the “global aircraft deicing standards.”

Exposure to weather conditions on the ground 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, 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 Code of Federal Regulations (14 CFR), EASA Operation Regulations (EU-OPS), Canadian Aviation Regulations (CAR), and others. Paraphrased, these rules specify that no one may dispatch or takeoff 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. In the event of differences or discrepancies in the requirements set out in this standard and any requirements set out in the domestic regulations applicable to the end user, the domestic regulation requirements shall supersede those set out in this standard.

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.

Changes in this revision (E) include:

a. Reorganized sections and edited titles (Sections 4, 5, 6, 7, and 8).

b. Added definitions.

c. Reorganized aircraft components.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AS6285E/

d. Added information on daily concentration tests.

e. Added information on glycol delivery methods.

f. Amended of post-deicing check after infrared deicing.

g. Introduced information about cold dry snow or ice crystals.

h. Added information in fluid related limits and application guidelines.

i. Edited caution statement about surface coatings and their effects on de/anti-icing fluids.

j. Reviewed and updated communication section.

k. Introduced recommended phraseology and references from ARP6257A.

TABLE OF CONTENTS

1. SCOPE

1.1 Field of Application

This SAE Aerospace Standard (AS) 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 manufacturer's 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 (Type I fluid) and AMS1428 (Type 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 manufacturer's 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 Fluid, Aircraft Deicing/Anti-Icing, SAE Type I

AMS1424/1 Deicing/Anti-Icing Fluid, Aircraft, SAE Type I Glycol (Conventional and Non-Conventional) Based

AMS1424/2 Deicing/Anti-Icing Fluid, Aircraft, SAE Type I Non-Glycol Based

AMS1428 Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV

AMS1428/1 Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV Glycol (Conventional and Non-Conventional) Based

AMS1428/2 Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV Non-Glycol Based

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

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

ARP1971 Aircraft Deicing Vehicle - Self-Propelled

ARP5660 Deicing Facility Operational Procedures

AS5681 Minimum Operational Performance Specification for Remote On-Ground Ice Detection Systems

AS5900 Standard Test Method for Aerodynamic Acceptance of AMS1424 and AMS1428 Aircraft Deicing/Anti-Icing Fluids

AS6286 Aircraft Ground Deicing/Anti-Icing Training and Qualification Program

AS6332 Aircraft Ground Deicing/Anti-Icing Quality Management

AS9968 Laboratory Viscosity Measurement of Thickened Aircraft Deicing/Anti-Icing Fluids with a Viscometer

2.1.2 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAA Holdover Time Guidelines: Winter 20xx-20yy (annual publication)

FAA, Notice N 8900.XXX Revised FAA-Approved Deicing Program Updates, Winter 20xx-20yy (annual publication)

Pilot/Controller Glossary

2.1.3 Transport Canada Publications

Transport Canada documents are available from Transport Canada, Tower C, Place de Ville, 330 Sparks Street Ottawa, Ontario K1A 0N5, Tel: 1-800-305-2059, www.tc.gc.ca.

Transport Canada Holdover Time Guidelines: Winter 20xx-20yy (annual publication)

Transport Canada, Guidelines for Aircraft Ground Icing Operations, TP 14052E, Issue x (annual publication)

AC 100-001 Glossary for Pilots and Air Traffic Services Personnel

2.1.4 ICAO Publications

Available from International Civil Aviation Organization, 999 University Street, Montreal, Quebec H3C 5H7, Canada, Tel: +1 514-954-8219, http://www.icao.int/.

Annex 2 Rules of the Air

Annex 10 Aeronautical Telecommunications - Volume I - Radio Navigation Aids

Annex 10 Aeronautical Telecommunications - Volume II - Communication Procedures Including Those with PANS Status

Annex 11 Air Traffic Services - Air Traffic Control Service, Flight Information Service, Alerting Service

Doc 4444 Procedures for Air Navigation Services - Air Traffic Management

2.1.5 Nav Canada Publications

Available from NAV Canada, AEROPUBS Office, 77 Metcalfe Street, Ottawa, ON K1P 5L6, Canada, Tel: +1 866-731-7827, www.navcanada.ca.

Ground Traffic Phraseology

IFR Phraseology

VFR Phraseology

2.1.6 Aircraft Manufacturer Manuals

Aircraft Manufacturer Manuals

Aircraft Operator Manuals

2.2 Abbreviations and Definitions

2.2.1 Abbreviations

ACARS	aircraft communications addressing and reporting system
APU	auxiliary power unit
CDF	central deicing facility
°C	degrees Celsius
CoA	certificate of analysis
CoC	certificate of conformance
DDF	designated deicing facility
DIS	deicing/anti-icing supervisor
EASA	European Union Aviation Safety Agency
EFB	electronic flight bag
FAA	Federal Aviation Administration
°F	degrees Fahrenheit
FOD	foreign object debris or foreign object damage
h	hours
HOWV	highest on-wing viscosity
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LOUT	lowest operational use temperature
LOWV	lowest on-wing viscosity

MB	message board
OAT	outside air temperature
QA	quality assurance
QC	quality control
SDS	safety data sheet
TC	Transport Canada

2.2.2 Definitions

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

2.2.2.1 Advisory Word Definitions

The following advisory words are to be used as defined.

MAY: This means the practice is encouraged and/or optional.

SHALL: This means the practice is mandatory. A synonym for must.

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

MUST: This means the practice is mandatory. A synonym for shall.

2.2.2.2 Definitions

ACTIVE FROST: Condition when frost is forming. Active frost occurs when (1) the aircraft surface temperature is at or below the frost point, or (2) there is water in liquid form (e.g. dew) on the aircraft surface and the surface falls to/or below 0 °C (frozen dew).

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.

ANTI-ICING FLUID:

1. Mixture of water and Type I fluid.
2. Premix Type I fluid.
3. Type II, III, or IV fluids.
4. Mixture of water and Type II, III, or IV fluids.

NOTE: For deicing/anti-icing purposes in a one-step procedure, fluids in 1, 2, and 4 shall be heated to ensure a temperature of 60 °C (140 °F) minimum at the nozzle.

ANTI-ICING CODE: Report given to the flightcrew that deicing/anti-icing has been carried out and the details of the anti-icing procedure that was applied. Also known as post-deicing/anti-icing report.

BRIX (DEGREES BRIX or °BRIX): Unit of measurement of refraction. See also refraction and refractometer.

CERTIFICATE OF ANALYSIS: A document, issued by a manufacturer, attesting that a lot or batch of a product fulfills the manufacturer's sales specification requirements, listing the tests, the test requirements, the test results on that lot or batch, the lot or batch number and a date.

CERTIFICATE OF CONFORMANCE: A document declaring that a product fulfills the requirements of a standard. Also known as certificate of conformity.

CHECK: Examination against a relevant standard by a trained and qualified person to ascertain satisfactory condition.

CHEMICAL CONTAMINATION: Condition when substances (chemicals) are present where they should not be or are at concentrations higher than they should be.

CLEAR ICE: Ice difficult to detect visually. It is normally formed in the area of the wing fuel tanks, caused by cold-soaking. Clear ice may break loose during or after takeoff, and poses a hazard particularly to aircraft with rear mounted engines.

COLD-SOAKING: Ice can form on aircraft surfaces 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. The low temperature of the fuel may come from flying at a high altitude, where cold temperature prevails, for a period of time, or from fueling with cold fuel. This phenomenon is known as cold soaking. While on the ground, the cold-soaked aircraft will cause ice to form when water as rain or as vapor (humidity), comes in contact with cold-soaked surfaces.

CONTAMINATION: All forms of frozen or semi-frozen deposits on an aircraft, such as frost, snow, slush, or ice (also known as frozen contamination).

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 are 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 FLUID:

1. Heated water.
2. Heated mixture of water and Type I fluid.
3. Heated premix Type I fluid.
4. Heated Type II, III, or IV fluids.
5. Heated mixture of water and Type II, III, or IV fluids.

NOTE: Unheated fluids are ineffective to deice.

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

DEICING PERSONNEL: Groundcrew personnel with roles and responsibilities associated with aircraft ground icing operations.

DEWPOINT: temperature at which unsaturated air must be cooled to cause saturation with respect to liquid water. The moisture condenses to liquid water either on surfaces as dew or as tiny liquid droplets suspended in air.

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).

FREEZING POINT: Temperature at which a liquid starts to become a solid.

FREEZING POINT BUFFER: The difference between the outside air temperature (OAT) and the freezing point of the fluid used.

FREEZING POINT BUFFER, NEGATIVE: Condition when the freezing point of a deicing/anti-icing fluid is above the OAT.

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/h (0.10 in/h) or 25 g/dm^2/h with a maximum of 0.25 mm (0.01 inch) in 6 minutes.

FREEZING RAIN, MODERATE: Precipitation of liquid water particles which freezes upon impact with the ground or other exposed objects. Moderate freezing rain may appear in the form of large drops or can appear to fall in sheets where individual drops are not identifiable. Moderate freezing rain has a measured intensity of between 0.10 to 0.30 in/h.

FREEZING RAIN, HEAVY: Precipitation of liquid water particles which freezes upon impact with the ground or other exposed objects. Heavy freezing rain can seem to fall in sheets and individual drops may not be identifiable. Heavy freezing rain has a measured intensity of more than 0.30 in/h.

FROST/HOARFROST: Tiny ice crystal formed on a surface at or below the frost point. Frost generally occurs with clear skies at temperatures below freezing point. Frost can also occur from the freezing of dew.

FROST, LOCAL: 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.

FROST POINT: temperature, at or below 0 °C, at which air undersaturated with moisture must be cooled (at constant pressure) to cause saturation with respect to ice. The moisture directly deposits, without going through the liquid phase, as frost on exposed surfaces providing nucleation sites. The frost point is higher (warmer) than the dewpoint by about 10% at a given humidity level in air. Air temperature readings given by a thermometer are applicable to the height above ground of the thermometer itself. Because cool air sinks and the ground often cools very quickly, especially on clear nights, the ground temperature on clear, still nights is invariably lower than the temperature only a few feet higher. Thus, frost can form even when a thermometer gives a reading above freezing. The same happens with aircraft—frost can form on aircraft when the thermometer air temperature reading is above 0 °C.

FUEL FROST: Frost, normally in the area of the wing fuel tanks, caused by the cold-soaking. Also known as non-environmental frost or cold-soaked fuel frost.

GROUNDCREW: Personnel with responsibilities for the handling, maintenance and servicing of an aircraft while on the ground, as well as the coordination of these activities.

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.

HIGHEST ON-WING VISCOSITY (HOWV): Highest viscosity of a thickened deicing/anti-icing fluid which is still aerodynamically acceptable.

HOARFROST: A synonym for frost. See frost/hoarfrost.

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.

LOWEST ON-WING VISCOSITY (LOWV): Lowest viscosity of a thickened deicing/anti-icing fluid for which the applicable holdover timetable can still be used.

LOWEST OPERATIONAL USE TEMPERATURE (LOUT): The LOUT is 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.

POST-DEICING CHECK: A check by qualified ground personnel to ensure that all critical surfaces are free of adhering contamination after the deicing procedure has been completed.

POST-DEICING/ANTI-ICING CHECK: A check by qualified ground personnel to ensure that all critical surfaces are free of adhering contamination after the deicing/anti-icing procedure has been completed.

POST-DEICING/ANTI-ICING REPORT: Report given to the flightcrew confirming that deicing/anti-icing has been carried out and the details of the deicing/anti-icing procedure that was applied.

PRE-DEICING PROCESS: A process to remove large quantities of frozen contamination prior to the regular deicing/anti-icing process with the objective of reducing the quantity of deicing fluid to be used.

PRE-FLIGHT CONTAMINATION CHECK: A check performed by the flightcrew or groundcrew prior to departure to verify the presence of adhering contamination to establish the need for deicing/anti-icing. It may be part of the flightcrew walk-around before the flight.

PRE-TAKEOFF CHECK: A check by the flightcrew prior to takeoff and within holdover time. This check is normally conducted from inside the flightdeck. It is normally accomplished by a continuous assessment of the conditions that affect holdover time and includes an assessment and adjustment of holdover time.

PRE-TAKEOFF CONTAMINATION CHECK: A check of the critical surfaces for adhering contamination. This check is accomplished after the holdover time has been exceeded and must be completed within 5 minutes prior to the beginning of takeoff.

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.).

QUALIFIED STAFF: Trained staff who have passed theoretical and practical training tests and have been qualified for performing this type of job; refer to AS6286.

QUALITY ASSURANCE: Is process-oriented, and it focuses on preventing quality issues. It is a proactive approach. An audit is done to validate QA processes, the quality procedures to be followed (e.g., “documented”)

QUALITY CONTROL: Is product-oriented and focused on identifying quality issues in manufactured products and performance of service. It is a reactive approach. Inspections/checks/tests are done as part of the QC procedure, to verify the quality of the available procedures and operations. (e.g., “implemented”).

REFRACTION: The bending of light as it passes from one transparent substance into another. For solutions, the refraction will vary upon the concentration of the solute in the solvent. Using a calibration curve, it is possible to determine the concentration of the solute in the solvent. For example, for aqueous glycol solutions, it is possible to determine the concentration of the glycol in water by measuring refraction with a refractometer and comparing the result to the calibration curve. Refraction can be expressed as a dimensionless number (index of refraction) or as a scale of concentration, e.g., degrees Brix (°Brix), or freezing point (°C or °F). See also refractometer.

REFRACTIVE INDEX: Unit of measurement of refraction expressed in the form of a dimensionless number. See also refraction and refractometer.

REFRACTOMETER: An instrument to measure refraction. Result of measurement with a refractometer can be expressed as a dimensionless number (index of refraction) or as a scale of concentration, e.g., degrees Brix (°Brix), or freezing point (°C or °F).

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 look similar to frost in a freezer; typically, rime ice has low adhesion to the surface and its surrounding rime ice particles.

SLUSH: Snow or ice that has been combined with water.

SNOW: 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.

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, and they do bounce and may break upon contact with hard ground.

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

TACTILE CHECK: Process by which a person touches 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.

THICKENED FLUID. A fluid that contains polymeric thickeners. AMS1428 Type II, III, and IV fluids are thickened fluids; AMS1424 Type I fluids are not thickened.

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 aircraft operator manuals.

3.2 Aircraft Operator

Shall have responsibility for:

- Aircraft ground deicing programs.
- The pilot-in-command.
- Management responsibilities.

3.3 Deicing Service Provider

Shall have 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 (QC) program. These procedures, which ensure compliance with the relevant regulations and global aircraft deicing standards such as AS6285, AS6286, and AS6332, 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 to this standard.
- Remote deicing/anti-icing instructions (when applicable).
- Sufficient number of trained and qualified deicing/anti-icing personnel.
- Qualified staff to coordinate and supervise the deicing/anti-icing treatments.
- Use of suitable deicing/anti-icing equipment meeting specification ARP1971.
- Special handling procedures for Type II, III, and IV deicing/anti-icing fluids to maintain quality.
- Post-deicing/anti-icing check (when applicable).
- Protocol for communications with flightcrew for both gate and remote locations (when applicable).
- Communicating the post-deicing/anti-icing report to the flightcrew.
- Documentation of all deicing/anti-icing treatments.
- Personnel safety arrangements.
- Provisions for tools and clothing for deicing/anti-icing personnel.
- Environmental arrangements.
- A QC 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 Regulatory Authority

Has the responsibility for:

- Regulatory and guidance material, plus the advocacy of the clean aircraft concept.
- The policies and standards that support the operability of the clean aircraft concept.
- Review and approval of airline operator ground deicing programs (as applicable).

3.6 Air Traffic Control

Has the responsibility for:

- The flow of aircraft through the regional system.

4. QUALITY MANAGEMENT

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 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 QA/QC program. QA 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 QA program in place. QA programs shall follow the standards published in AS6332.

4.2 Quality Control Program

A QC program shall cover all aspects of aircraft ground deicing/anti-icing and follow the standards published in AS6332. A QC shall include, but is not limited to, the following checks:

- Procedures and instructions are up to date.
- Responsibilities and tasks are clearly defined and up to date.
- Communication procedures/protocols are up to date.
- All personnel are 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/centralized) deicing/anti-icing facility (if applicable).
- Reporting methods and reports are up to date.

NOTE 1: Prior to the start of each winter, perform all above listed checks.

NOTE 2: During each winter season, perform QC checks on deicing/anti-icing fluids from all spray nozzles at operational settings on a regular basis and file test results until the start of the next winter period.

4.3 Fluid Quality Control

To ensure the necessary safety margins are maintained in the deicing/anti-icing operation, the fluid used to both deice 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 and tests. Results of all testing shall be recorded.

4.3.1 Fluid Delivery and Acceptance

4.3.1.1 Fluid Delivery Methods

Some of the most common delivery methods and their precautions are the following:

4.3.1.1.1 Bulk Shipments (e.g., Tank Trucks and Rail Cars)

This delivery method consists of the usage of reusable vessels which can hold a larger fluid quantity. After performing the proper fluid quality controls, it is then transferred into the receiver's storage.

The fluid supplier shall provide an assurance that one of the following has been met prior to loading the bulk shipping container for delivery to the customer:

a. The shipping container and included delivery hoses were cleaned.

b. The previous load consisted of fluid identical to the delivered fluid.

4.3.1.1.2 Packaged Goods (i.e., Totes, Pails, or Drums)

When de/anti-icing fluid are delivered in a single or multiple containers (i.e., totes, pails, or drums) all sealed and shipped by the fluid manufacturer (or authorized company), fluid supplier shall provide all pertinent documentation as required in 4.3.1.3.

4.3.1.2 Fluid Delivery Acceptance

Fluid acceptance consists of delivery documentation checks, seal checks and fluid tests. Fluid acceptance check shall be performed for each delivery of aircraft deicing and anti-icing fluids before the first use of the delivered fluid for filling a storage tank or deicing vehicle tank.

4.3.1.3 Fluid Delivery Documentation

a. The delivery shall be accompanied by a certificate of analysis.

   1. For Type I, II, III, and IV fluids, the certificate shall include delivery specification limits and test results of the following:

      i. Appearance.

      ii. Refraction.

      iii. pH.

   2. For deliveries of Type II, III, and IV fluids, the certificate shall also include (delivery) viscosity specification limits and test results for laboratory viscosity testing.

b. The documentation and paperwork accompanying the delivery shall be checked to verify the following:

1. The delivered fluid name corresponds to the fluid ordered.
2. The delivered fluid brand name corresponds to product identification labels or tags for each delivery vessel.
3. The delivered fluid concentration corresponds to product identification labels or tags for each delivery vessel.
4. The lot or batch number on delivery documents correlate with other shipping documents provided.
5. The test results noted on the certificate of analysis meet the applicable fluid manufacturer's specification limits.

4.3.1.4 Shipment Seal Checks

a. Shipment seals shall be checked to ensure:

1. The product has not been tampered with.
2. Identification numbers align with those noted on delivery documentation (where applicable).

b. If seals contain identification numbers, the numbers should be noted on acceptance documentation.

4.3.1.5 Fluid Samples

A fluid sample shall be taken from the delivery vessel during bulk shipping prior to fluid transfer. A sample from each separate compartment is required, when applicable.

For packaged goods deliveries (i.e., sealed totes, pails, or drums), fluid testing can be postponed until the container is opened (unsealed) prior to be used or transferred. After opened and sampled, if delivery includes multiple containers, it is considered acceptable if only one sample from each production lot or batch is taken.

NOTE: Deicing/anti-icing fluids may degrade even when stored under appropriate conditions. Fluid manufacturers may assign a shelf life which is the time for which a product is expected to be useable or saleable when stored under appropriate conditions. For a deicing/anti-icing fluid, shelf life sets the time after which a fluid, under appropriate storage conditions, should be retested to verify that it still meets specification requirements. Consult the fluid manufacturer for further information.

4.3.1.6 Sample Tests

a. The following tests shall be performed on each sample taken at delivery:

1. Appearance (visual examination):
    i. Color.
    ii. Foreign body contamination (e.g., rust particles, debris, etc.).
2. Refraction check (refractive index or freezing point) to verify fluid concentration.

b. The following tests are optional for each sample. These checks can be helpful if fluid degradation is suspected:

1. pH.
2. Field viscosity or laboratory viscosity tests for Type II, III, or IV fluids.

c. All test results shall be within the fluid manufacturer's specification limit.

4.3.1.7 Nonconformities or Discrepancies

Users and service providers shall have a documented procedure in place on the appropriate action to be taken when irregularities or discrepancies are identified during the fluid delivery documentation checks and fluid sample tests.

Fluid manufacturers should have information contained within their documentation outlining specific procedures and/or contact information to assist and provide support to service providers in such occurrences.

4.3.2 Fluid Preseason and Within-Season Tests

Fluids that are applied to the aircraft shall meet the fluid manufacturer's specification or in-service limitations, as applicable. A program shall be in place that assures the safe use, handling and performance parameters of fluids are always followed and met.

One way of complying with this requirement is to carry out a preseason quality test and within-season tests as described below.

4.3.2.1 Type I Fluid

4.3.2.1.1 Test Frequency

These tests shall be performed:

a. At the start of the deicing season.

b. On any vehicle or storage tank when fluid contamination or degradation is suspected.

4.3.2.1.2 Fluid Samples

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 tests on the fluid samples:

a. Appearance (visual examination).

    1. Color.

    2. Foreign body contamination (e.g., rust particles, debris, etc.).

b. Refraction.

c. pH.*

* Perform this test if fluid degradation or contamination is suspected.

4.3.2.2 Type II, III, and IV Fluids

4.3.2.2.1 Test Frequency

These tests shall be performed:

a. At the start of the deicing season.

b. On any vehicle or storage tank when fluid contamination or degradation is suspected.

c. 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.).

4.3.2.2.2 Fluid Samples

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 tests:

a. Appearance (visual examination).

    1. Color.

    2. Foreign body contamination (e.g., rust particles, debris, etc.).

b. Refraction.

c. pH.

    1. Perform this test if fluid degradation or contamination is suspected.

d. Laboratory viscosity.

4.3.2.3 Sample Test Requirements

- Results of the appearance, refraction and pH tests shall be within the limits set by the applicable fluid manufacturer specification or in-service limits.

- Results of the Type II, III, and IV viscosity tests on samples from spray nozzles shall be no lower than the lowest on-wing viscosity (LOWV) and no higher than the highest on-wing viscosity (HOWV). Fluids with a viscosity less than the LOWV shall not be used with holdover time guidelines.

- Results of the viscosity tests on samples from storage tanks shall be within the limits needed to ensure the viscosity of fluid when applied to aircraft will remain within the LOWV and the HOWV. Any expected degradation during fluid storage and handling and during the use of fluid application equipment must be considered.

NOTE: The LOWV for specific fluids are listed in Transport Canada and FAA Holdover Time Guidelines. The HOWV for specific fluids are provided by the applicable fluid manufacturer. The LOWV and HOWV are unique for each specific fluid and fluid concentration (i.e., 50%, 75%, and 100%).

4.3.3 Daily Concentration Tests

Fluids or fluid/water mixture samples shall be taken from the deicing/anti-icing equipment nozzles or manufacturer's authorized sample ports on a daily basis when the equipment is in use. Perform a refraction test 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.

4.3.3.1 Type I Fluid from Nozzles

- Maximum permitted concentration shall not be exceeded.

- For use in a one-step method and in the second step of a two-step method, the concentration shall be such that the freezing point of the fluid is at least 10 °C (18 °F) below the OAT.

- For use in the first 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 I 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 Fluids

- For fluids from nozzles or 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 I, II, III, or IV Fluids

SAE Type I, 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 manufacturer’s recommendations.

4.3.5 Fluid Test Methods

The following tests may be performed by any appropriate equivalent method.

a. Appearance:

   1. Put fluid from the sample into a clean transparent bottle.

   2. Check visually for color.

   3. Check visually for any kind of contamination (e.g., rust particles, debris, rubber, or discoloration, etc.).

b. Refraction:

   1. Ensure a functionality check was performed in accordance with manufacturer’s instructions.

   2. Put a fluid drop taken from the sample onto the test screen of the refractometer and close the cover plate.

   3. Read the value (usually expressed as refractive index, degrees Brix or freezing point) 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).

   4. Compare the refraction result to the specification limit or in-use limit, as appropriate.

   5. Clean the refractometer by wiping with a water-wet cloth, wipe dry, and return it to the protective cover.

c. pH:

   1. This test 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 test:

1. This test may be performed using the fluid manufacturer's recommended method, like a falling ball or the Stony Brook device. Read the value and compare with the limits for the fluid.

e. Laboratory viscosity test:

1. Perform the viscosity test using the fluid manufacturer's method or AS9968. Compare the viscosity values with the applicable limits.

4.3.6 Nozzle Fluid Sampling Procedure for Type II, III, or 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 deice 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 QC 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 (3 to 10 feet), 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.

1. Select the required flow rate/spray pattern for the fluid to be sampled simulating routine operations.

2. Spray the fluid to purge the lines and check the concentration of a sample, taken from the gun/nozzle after purging.

3. Should the refraction 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 L of fluid, before the lines are completely purged).

4. Direct the fluid onto the sampling surface and spray an adequate amount of fluid to allow for a 1 L sample to be taken.

b. Trashcan method:

Items required:

1. Large garbage cans, buckets, or 55-gallon drums.

2. Large trash can liners.

3. Sample bottle that is clean and dry.

Procedure for nozzle sample:

1. Set trash cans out and put two liners in each trash can.

2. Weigh the trash can down with sand or blocks.

3. Stand about +1 to 3 m (4 to 10 feet) away from the cans.

4. Open the nozzle and spray into one of the trash cans so that the lines are purged of any old fluid.
5. When the line has been purged, move the nozzle to the next trash can, keeping the nozzle open.
6. Do not close the nozzle and restart as that will shear the fluid.
7. Spray 2 to 3 gallons (8 to 12 L) into the second trash can.
8. 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:

1. Manufacturer's brand name and full name and type of the fluid (e.g., Kilfrost ABC-3/Type II).
2. Identification of deicing/anti-icing equipment (e.g., Elephant Beta DT04, Fixed Rig R001, etc.).
3. Detail where the sample was taken from (e.g., nozzle, storage tank, or equipment tank).
4. Mixture strength (e.g., 100/0, 75/25, etc.).
5. Station (e.g., BAK, etc.).
6. Date sample was taken.

5. AIRCRAFT GROUND DEICING/ANTI-ICING METHODS

5.1 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 procedure 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 5.4 and 5.5 apply for guidance regarding fluid limitations.

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

5.2 Pre-deicing Procedure to Be Done Prior to Deicing/Anti-Icing

Companies may employ a pre-deicing procedure prior to the main deicing procedure, 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 procedure 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-deicing procedure is used, make sure that the subsequent deicing procedure removes all frozen contamination including the contamination that may have formed on surfaces and/or in cavities due to the pre-deicing procedure.

5.3 Infrared Deicing

This subsection 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 the 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 contaminant. Wet surfaces require an application of heated deicing fluids to preclude refreezing after removal of the 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 refreezing of water which may remain in hidden areas.

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

c. Post-deicing check: The aircraft shall be checked in accordance with the requirements of Section 7.

d. Anti-icing: If anti-icing is required, it shall be accomplished in accordance with 5.7.2. If anti-icing is performed inside the facility, infrared power levels must be adjusted as required during the anti-icing procedure to prevent the re-accumulation of frozen contamination because 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.

5.4 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 7) are removed from the specified surfaces during the deicing procedure.

CAUTION: Consult aircraft maintenance manuals for limitations for the maximum application pressure, temperature, and the use of glycol (AMS1424/1 and AMS1428/1) versus non-glycol (AMS1424/2 and AMS 1428/2) fluids.

5.4.1 Removal of Contaminants

For maximum effect, fluids shall be applied close to the surface to minimize 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 refreezing for a period of time, depending on aircraft skin and OAT, the fluid used, the mixture strength, and the weather.

5.4.1.1 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.

5.4.1.2 Removal of Snow

A nozzle setting sufficient to flush off deposits and minimize 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 5.4.1.3 should be utilized. 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-deicing procedure before attempting a normal deicing procedure.

5.4.1.3 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 freezing 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.

5.4.1.4 Cold Dry Snow or Ice Crystals

Cold dry snow or ice crystals, in very cold conditions [generally below -10 °C (14°F)], may not adhere to a cold dry aircraft nor its critical surfaces. Under these conditions, it may swirl as it blows across the surfaces, making it evident it is not adhering. Therefore, the critical surfaces remain free of adhering contaminants.

However, if frozen contamination has accumulated on critical surfaces, it must be adequately removed. It cannot be assumed that these accumulations will blow off during takeoff.

During cold dry conditions, the air operators will need take into consideration the following elements:

1. Refueling with fuel warmer than the wing skin temperature may create a condition whereby previously non-adhering precipitation may adhere to the wing surfaces.

2. The use of heated deicing fluids may increase the risk of cold dry snow or ice crystals to adhere to critical surfaces post application. Under such operational conditions, an anti-icing treatment might need to be considered.

   CAUTION: A close monitoring of de/anti-icing fluid's LOUT is required to ensure a safe operation.

3. Monitor the location of heat-releasing equipment such as ground power units or bridges that may create conditions for non-adhering precipitation to start adhering to aircraft surfaces.

4. The location where the aircraft is parked might increase the risk for non-adhering precipitation to start adhering (e.g., one wing in the sun, a building obstructing the wind, etc.).

5. Operations in close proximity to other aircraft may cause snow, ice particles, or moisture to be blown onto critical aircraft components; or can cause dry snow/ice crystals to melt and refreeze on aircraft critical surfaces.

If it cannot be adequately demonstrated that cold dry snow or ice crystals is not adhering or accumulating, then it must be removed before takeoff.

CAUTION: Aircraft with rear mounted engines are more susceptible to ingest frozen accumulation that might cause damage or engine failure.

5.4.2 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, and aircraft manufacturer's instructions should be consulted. Ice, snow, or frost dilutes the fluid. Apply enough hot deicing fluid to ensure that refreezing 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.

5.4.2.1 Wings, Horizontal Stabilizers, and Elevators

The direction of the spray shall be from the leading edge to the trailing edge in the vicinity of any control surfaces (i.e., the rudder). Caution must be used to ensure fluid is not sprayed directly into any vertical tail or control surface openings.

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.

CAUTION: Wing surface temperatures can be considerably below ambient temperature due to contact with cold fuel and/or proximity to large masses of cold-soaked metal. Use a fluid/water mixture with a higher concentration of glycol than is usually required by the OAT to prevent refreezing.

5.4.2.2 Lower Wing Surface (Underside 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 flightcrew: “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 refreezing.

5.4.2.3 Vertical Surfaces

Start at the top and work down to the base of any vertical surface, spraying from forward to aft in the vicinity of control surfaces.

5.4.2.4 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 manufacturer’s manuals. Hoarfrost may be allowed in accordance with the aircraft manufacturer’s manuals.

5.4.2.5 Nose/Radome Area and Flightdeck 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 flightdeck 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 flightdeck windows should be removed prior to departure, using a diluted Type I fluid, squeegees, or equivalent. If flightdeck windows are contaminated with thickened fluids, use water or an approved windshield cleaner [use of a low freezing point windshield washing fluid is recommended when OAT is at or below 0 °C (32 °F)].

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

5.4.2.6 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, gravel deflectors, 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.

5.4.2.7 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.

5.4.3 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 localized 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 type of fluid; 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 upon 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 flightcrew: “Local area deicing only. Holdover times do not apply.”

5.5 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 the 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.

Prior to flight, the aircraft must be deiced, unless the integrity of the fluid can be ensured. Deice in accordance with 5.8; whenever possible, to reduce the potential for dried residue build up (second caution of 5.6.2).

NOTE: Dehydration (water evaporation) of Type II, III, and IV fluids 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 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: Type I fluids provide limited holdover effectiveness when used for anti-icing purposes.

CAUTION: AMS1424/2 and AMS1428/2 acetate- or formate-based fluids when used for deicing:

- May significantly shorten the holdover times of Type II, III, and IV fluids when used in combination with these fluids.
- May cause corrosion on aircraft materials.

Refer to aircraft manufacturers documentation, fluid manufacturer recommendations and AMS1424/1, AMS1424/2, AMS1428/1, and AMS1428/2 for more information.

5.5.1 Anti-Icing Fluid Application Strategy

The spraying procedure 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. Spray from the leading edge to the trailing edge on wings, horizontal, and vertical stabilizers.

To use Type I holdover times guidelines in all conditions, including active frost, an additional minimum of 1 L/m^2 (~2 gallons/100 ft^2) of heated Type I fluid/water mixture must be applied to the surfaces after all frozen contamination is removed. This application is necessary to heat the surfaces, as heat contributes significantly to the Type I fluid holdover times. The Type I/water mixture used for anti-icing must be selected so that the freezing point of the mixture is at least 10 °C below the OAT and heated so the nozzle temperature is at least 60 °C (140 °F).

For Type II, III, or IV fluids (non-Newtonian fluids), a sufficient amount is indicated by fluid just beginning to run off of the leading and trailing edges of horizontal surfaces. Apply sufficient fluid to achieve an even, uniform layer, typically achieved by using 1 to 3 L/m^2 (~2 to 6 gallons/100 ft^2), depending on the type of non-Newtonian anti-icing fluid used.

Consult the fluid manufacturer for any applicable fluid specific application guidance.

Refer to local regulatory documents, such as the FAA Holdover Time Guidelines: Winter 20xx-20yy (annual publication) or to Transport Canada Holdover Time Guidelines: Winter 20xx-20yy (annual publication).

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. See 5.5.2 for more information about holdover time limitations when anti-icing with non-Newtonian fluids on vertical surfaces.
- 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 center-line engine aircraft).

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.

NOTE: SAE Type II, III, and IV fluids used for anti-icing purposes are normally applied unheated on clean aircraft surfaces, but they may be applied heated and diluted for a one-step procedure. Refer to the fluid manufacturer's recommendation.

5.5.2 Holdover Time

Holdover time is obtained by anti-icing fluids remaining on the aircraft surfaces. With a one-step procedure, the holdover time begins at the start of the treatment; with a two-step procedure, it begins 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 heat transfer and the thin liquid wetting film, 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 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, such as strong winds, jet blast, etc. Aircraft surfaces with steeper angles (e.g., vertical stabilizer, deployed flaps, etc.) might also have an effect on holdover times that needs to be considered.

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 1: 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 2: Surface coatings, including but not limited to waxes, 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. Test all surface coatings against AIR6232 to ensure they do not interfere with the performance of deicing/anti-icing fluids. For more information, consult the fluid and aircraft manufacturers.

5.5.3 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 5.4 and 5.5, 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).

5.5.3.1 Procedure - Local Frost Prevention

Using suitable spray equipment, apply a proper coating of undiluted 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.

5.5.3.2 Limits/Precautions for Local Frost Prevention - Local Frost Prevention

Procedure limitation: This local frost prevention procedure is neither a substitute for standard deicing and anti-icing procedures in accordance with 5.4.1 and 5.5.1, 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.

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

b. Training: This procedure shall only be carried out by trained and qualified personnel (refer to AS6286).

5.5.3.3 Application Limits - Local Frost Prevention

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 procedure shall be performed (see 5.4 and 5.5).

5.5.3.4 Symmetrical Treatment Requirement - Local Frost Prevention

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.

5.5.3.5 Holdover Time - Local Frost Prevention

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

5.5.3.6 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).

5.5.3.7 Flightcrew Information - Local Frost Prevention

Where this procedure was performed, flightcrew shall be advised of the treatment and that holdover times do not apply. This may be communicated through flight release or other documentation, or verbally when the flightcrew is onboard. See 8.4.1.1 (first note) and 8.6.1.1 for more information.

5.6 Limits

5.6.1 Fluid Related Limits

Applied fluids: The freezing point depressant concentration of the applied fluid must not exceed the highest freezing point depressant concentration (as measured by refraction) at which the fluid met the aerodynamic acceptance test. For applicable values, refer to the fluid manufacturer’s documentation.

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.

Temperature limits (see 5.8 for information on application tables): When performing two-step deicing/anti-icing, the freezing point of the fluid used for the first step shall be at or below the OAT.

Type I fluids: The freezing point of the Type I fluid mixture used for either one-step procedure or as a second step in the two-step procedure, shall be at least 10 °C (18 °F) below the OAT. In no case shall this temperature be lower than the LOUT.

CAUTION 1: 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 2: All Type I fluids have a maximum concentration mix related to the aerodynamic acceptability. Refer to fluid manufacturer's documentation.

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

NOTE: Type II, III, and IV fluids do not have a published holdover times below -25 °C (-13 °F) in active frost conditions. Refer to local regulatory documents, such as the FAA Holdover Time Guidelines: Winter 20xx-20yy (annual publication) or to Transport Canada Holdover Time Guidelines: Winter 20xx-20yy (annual publication) for more information.

5.6.2 Fluid Application Limits

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 5.8). Ensure that any remaining fluid from any previous treatment is flushed off. Anti-icing only is not permitted.

CAUTION 1: The application of Type II, III, and IV fluids, especially when used in a one-step procedure or in the first step of a two-step procedure, may cause fluids 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.

CAUTION 2: The application of hot water or heated Type I fluid in the first step of a two-step procedure 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 procedure or in the first step of a two-step procedure, 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 1: 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 2: If removal of contamination is required on the lower side of the wings and the horizontal stabilizer and elevator, deicing fluid shall be applied sparingly to minimize fluid flow into drain holes. Whenever possible, use Type I only. Consult the aircraft manufacturer's documentation.

5.6.3 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.

5.7 Procedure Precautions

5.7.1 One-Step Procedure

This is performed using heated deicing/anti-icing fluids (see 5.4.1). The correct fluid concentration is chosen with regard to desired holdover time, dictated by OAT and weather conditions (see 5.8.). The fluid used to deice the aircraft remains on the aircraft surfaces to provide limited anti-ice capability.

CAUTION 1: 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 2: The application of Type II, III, or IV fluids, especially when used in a one-step procedure, may cause fluids 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 1: If a Type II, III, or IV fluid is used in a one-step procedure, then an appropriate inspection and cleaning program shall be established. Whenever suitable, deice and anti-ice with only Type I.

NOTE 2: 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 3: 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 minimize fluid flow into drain holes. Whenever possible, use Type I only. Consult the aircraft manufacturer's documentation.

5.7.2 Two-Step Procedure when the First Step is Performed with Deicing Fluid

The correct fluid(s) shall be chosen with regard to OAT (see 5.8). 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 tables). The second step shall be performed before the first step fluid freezes, if necessary, area by area. Service providers shall ensure the first step fluid and the second step fluid used on aircraft are compatible. This can be accomplished by contacting the respective fluid manufacturer(s).

Use a second step spraying technique to cover completely the first step fluid (for example, using the method described in 5.5.1) with a sufficient amount of second step fluid. For guidance on the amount of fluid, refer to AS6286 and/or the fluid manufacturer's documentation.

Where refreezing occurs following the initial treatment, both the first and second step must be repeated.

CAUTION 1: 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 2: The application of Type II, III, or IV fluids, especially when used in a one-step procedure or in the first step of a two-step procedure, may cause fluids 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 procedure will minimize the formation of dried residues.

NOTE 1: If a Type II, III, or IV fluid is used in the first step of a two-step procedure, then an appropriate inspection and cleaning program shall be established. Whenever suitable, deice and anti-ice with only Type I.

NOTE 2: 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 3: 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 deiced, the deicing fluid freezing point must be low enough to prevent refreezing.

5.7.3 Holdover Time of Applied Fluid

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.

5.7.4 Symmetrical Treatment

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. Procedures in 5.5.1 shall be followed if an anti-icing treatment is to be performed on the aircraft.

CAUTION: The aircraft is considered UNSAFE if this requirement is not met.

5.7.5 Aircraft Configuration

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

5.7.6 Air Conditioning and Bleed Air

Engines shall remain running at idle or can be shut down during deicing/anti-icing operations. Air conditioning and/or auxiliary power unit (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.

5.7.7 Spray Precautions and Sensitive Areas

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

5.7.7.1 Sensors

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.

5.7.7.2 Engines

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.

5.7.7.3 Windows, Doors, and Emergency Exits

Do not direct fluid spray onto the flightdeck 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.

Do not spray deicing/anti-icing fluids directly onto windows, doors, and emergency exits/hatches to prevent any fluid infiltration.

5.7.7.4 Fluid Removal from Flightdeck Windows

If Type II, III, or IV fluids are used, all traces of the fluid on flightdeck 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 flightdeck windows 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.

5.7.7.5 Folding Wings

Do not direct high pressure fluid spray onto the hinge recesses or bushings on the lower extended lugs of folding wing devices, as this can cause lubricants to be washed away. Fan spray or overspray are allowed.

5.7.7.6 Landing Gear and Gravel Deflectors

Landing gear (including the gravel deflector and spray/foreign object debris (FOD) deflectors on certain types of aircraft) and wheel bays shall be kept free from the buildup of slush, ice, or accumulations of blown snow.

5.7.7.7 Balance Bays, Gaps, and Hinges

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.

5.7.8 In-Flight Ice Accretion and Splash Up

Contamination buildup 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 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 shall be inspected, and any frozen deposits removed prior to departure.

5.7.9 Engine Ice

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.

5.7.10 Fluid Residues

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.

5.7.11 Treatment Interruption

A deicing/anti-icing procedure should be continuous and as short as possible.

If a treatment is interrupted (for example, a truck running out of fluid), the flightcrew shall be immediately informed, stating:

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

Before continuing the treatment:

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

Carry out the treatment as agreed.

5.7.12 Clear Ice Precautions

Clear ice can form on aircraft surfaces below a layer of snow or slush. Therefore, it is important that surfaces are closely examined following each deicing procedure, 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.
- 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 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.

5.7.13 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 procedure 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 procedure 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 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 deicing/anti-icing company).
- Result of the third-party inspection (e.g., no visual damage detected or damage suspected/present).

Groundcrew involved in the deicing/anti-icing procedure 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. Flightcrew should be trained on the purpose and functionality of a proximity sensor, and the specific company procedures and requirements in the event of contact.

5.8 Fluid Application Guidelines

The fluid application guidelines are part of local regulatory documents, such as the FAA Holdover Time Guidelines: Winter 20xx-20yy (annual publication) or to Transport Canada Holdover Time Guidelines: Winter 20xx-20yy (annual publication).

CAUTION: Failure to follow proper fluid application guidance may result in reduced protection of uncertain duration.

6. CHECKS

The decision whether deicing/anti-icing is required shall 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 (in-flight ice accretion).
- During taxi to the gate occurring in icing and/or snow conditions.
- Following an inspection or check by the flightcrew 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 flightcrew arrival.

6.1 Contamination Check to Establish the Need for Deicing

A contamination check shall include all areas mentioned in 7.1 through 7.8, 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 procedure; this shall be followed by anti-icing treatment when required.

Where an aircraft has been deiced and/or anti-iced some time prior to the arrival of the flightcrew, 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 aircraft requiring treatment.

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 contamination check. Aircraft operators shall make arrangements for suitably qualified personnel to meet these requirements.

6.2 Tactile Check

The need for a specific tactile check shall be determined by the aircraft manufacturer, air operator and/or local regulator.

6.3 Post-Deicing/Anti-Icing Check

An aircraft shall not be dispatched after a deicing/anti-icing procedure 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 sensors, and angle of attack sensors. This check shall also include any other parts of the aircraft on which a deicing/anti-icing procedure 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 flightcrew must ensure that they have received confirmation that this post-deicing/anti-icing check has been accomplished.

NOTE 1: 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.

NOTE 2: During engine(s)-on deicing operations, the access/view to certain aircraft components is restricted and cannot be checked (e.g., Inboard underwings between the running wing mounted engines and the fuselage). These areas should be inspected during the pre-flight contamination check and if treatment is required, advise the deicing personnel for further coordination and removal.

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:

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 (5.5.1).

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). If contaminated, advise flightcrew to consider its removal.

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

Once the treatment has been completed, the deicing operator will conduct a close visual check of the surface where the treatment commenced, to ensure that it has remained free of contamination.

6.4 Pre-Takeoff Check

The flightcrew shall continually monitor the weather conditions after the deicing/anti-icing treatment. Prior to takeoff, a flightcrew 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 flightdeck.

6.5 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.

6.6 Flight Control Check

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

7. 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.

7.1 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.

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

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

NOTE: Ice ridges can form on different areas of the aircraft, especially on the nose of the fuselage while on the ground. These ridges will disrupt air flow into the air data sensing devices and which can result in false measurements. All contamination shall be removed from these areas.

7.3 Engines

Engine inlets (including the leading edge), exhaust, thrust reversers, cooling intakes, control system probes, vortex dissipators, 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.

7.4 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.

7.5 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 and wheel components.

7.6 Fuel Tank Vents

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

7.7 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.

7.8 Flightdeck Windows and Nose or Radome Area

Any significant deposits of frost, snow, slush, or ice on the flightdeck windows or on areas forward of the flightdeck windows shall be removed prior to departure. Heated flightdeck windows will not normally require deicing. Any forward area from which fluid may flow back onto flightdeck windows during taxi or subsequent takeoff shall be free of fluid prior to departure.

If SAE Type II, III, or IV fluids have been used, all traces of the fluid on flightdeck windows shall be removed prior to departure, with particular attention paid to windows fitted with wipers. Thickened fluid (SAE Types 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 effluent to freeze near sensors, requiring deicing.

7.9 Dried Thickened Fluid Residues When the Aircraft Has Not Been Flown after Anti-Icing

Dried thickened-fluid (SAE Types II, III, or IV) residues can occur when surfaces have been deiced/anti-iced but the aircraft has not 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.

7.10 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.

8. COMMUNICATIONS

Communication between flightcrew and groundcrew shall be established, as per described in this document, to ensure full understanding from all parties and enhance the safety and efficiency of operations.

All companies providing deicing/anti-icing services shall have a communication program/protocol in accordance with regulatory requirements and guidance, industry standards, and the aircraft operator's program as locally required.

8.1 Communication Procedures

Persons communicating with the flightcrew 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 flightcrew and groundcrew, local language may be used (refer to the current version of training document AS6286); otherwise, English is the preferred language of communication.

Communication between the flightcrew and the groundcrew will usually be achieved using a combination of documentation, visual and/or verbal communication. For treatments carried out with flightcrew onboard, the use of flight interphone (headset) or VHF radio will usually be required. Message boards (electronic/written) may also be used at designated deicing facilities (DDF) and other deicing locations to enhance communications. Use of hand signals is not recommended, except for the final “all clear” signal.

NOTE: In circumstances where an aircraft is deiced or anti-iced overnight and/or where flightcrew members are not onboard, the subsequent flightcrew communication procedures do not apply. In these circumstances, the air operator should be advised the treatment details, and where applicable, the anti-icing code elements where anti-icing was performed.

8.2 Communication Prior to Starting Deicing/Anti-Icing Procedures

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

b. Before treatment starts, the flightcrew 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 personnel shall wait for confirmation that this has been completed before commencing the treatment.

c. For treatments conducted without the flightcrew present, suitably qualified staff member shall be nominated by the aircraft operator to confirm the treatment required (when applicable) and to confirm the correct configuration of the aircraft.

Follow the suggested phraseology in Table 1.

8.3 Communication During Deicing/Anti-Icing Procedures (Flightcrew Onboard)

During engines-on deicing/anti-icing operations, a constant two-way verbal communication shall be maintained between deicing personnel and flightcrew, and a visual positive hold control method shall be utilized during the deicing/anti-icing procedure.

During engines-off deicing/anti-icing operations, where constant two-way verbal communication is not possible, deicing personnel shall inform the flightcrew that communications will be disconnected and re-established on completion of the deicing/anti-icing process. In the event of abnormal operations associated with the aircraft, flightcrew shall follow air operator procedures for re-establishing communications (i.e., flashing of landing and/or taxi lights).

8.3.1 Abnormal Communication

8.3.1.1 Communication for Proximity Sensor Activation by Physical Contact

For equipment types furnished with a proximity sensor requiring physical contact in order to activate (see 5.7.13 for further information) and, in the event of sensor contact, the flightcrew shall be informed using the suggested phraseology in Table 3.