BRITISH STANDARD AEROSPACE SERIES

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ISO 11076:
1993

Aerospace — Aircraft de-icing/anti-icing methods with fluids

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Committees responsible for this British Standard

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Association of Webbing Load Restraint Equipment Manufacturers
British Airways
British Narrow Fabrics Association
Civil Aviation Authority (Airworthiness Division)
Health and Safety Executive
Ministry of Defence
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Society of Motor Manufacturers and Traders Ltd.

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National foreword

This British Standard has been prepared under the direction of the Aerospace Standards Policy Committee. It is identical with ISO 11076:1993 *Aerospace — Aircraft de-icing/anti-icing methods with fluids*, published by the International Organization for Standardization (ISO).

Cross-references

International Standard	Corresponding British Standard
ISO/11075:1993	BS M 75:1994 *Aerospace — Aircraft de-icing/anti-icing Newtonian fluids, ISO type I* (Identical)
ISO 11077:1993	BS M 77:1994 *Aerospace — Self-propelled de-icing/anti-icing vehicles — Functional requirements* (Identical)
ISO 11078:1993	BS M 78:1994 *Aerospace — Aircraft de-icing/anti-icing non-Newtonian fluids, ISO type II* (Identical)

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 Scope

This International Standard establishes the minimum requirements for ground-based aircraft de-icing/anti-icing with fluids to ensure the safe operation of transport aircraft during icing conditions (see also **8.3.2**). All requirements specified herein are applicable only in conjunction with the referenced International Standards. This International Standard does not specify requirements for particular aeroplane model types.

NOTE 1 Particular airline or aircraft manufacturers' published manuals, procedures or methods supplement the information contained in this International Standard.

Frost, ice or snow deposits, which can seriously affect the aerodynamic performance and/or controllability of an aircraft, are effectively removed by the application of the procedures specified in this International Standard.

De-icing/anti-icing by mechanical means is not covered by this International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 11075:1993, *Aerospace — Aircraft de-icing/anti-icing Newtonian fluids, ISO type I.*

ISO 11077:1993, *Aerospace — Self-propelled de-icing/anti-icing vehicles — Functional requirements.*

ISO 11078:1993, *Aerospace — Aircraft de-icing/anti-icing non-Newtonian fluids, ISO type II*[1).]

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1
de-icing

procedure by which frost, ice or snow is removed from an aircraft in order to provide clean surfaces

3.2
de-icing fluid

a) heated water;

b) ISO type I fluid in accordance with ISO 11075;

c) mixture of water and ISO type I fluid;

d) ISO type II fluid in accordance with ISO 11078;

e) mixture of water and ISO type II fluid.

NOTE 2 De-icing fluid is normally applied heated in order to assure maximum efficiency.

3.3
anti-icing

precautionary procedure which provides protection against the formation of frost or ice and accumulation of snow on treated surfaces of the aircraft for a limited period of time (holdover time)

3.4
anti-icing fluid

a) ISO type I fluid in accordance with ISO 11075;

b) mixture of water and ISO type I fluid;

c) ISO type II fluid in accordance with ISO 11078;

d) mixture of water and ISO type II fluid.

NOTE 3 Anti-icing fluid is normally applied cold on clean aircraft surfaces.

3.5
de-icing/anti-icing

combination of the procedures described in **3.1** and **3.3**. It may be performed in one or two steps

3.6
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 protected surfaces of an aircraft, under weather conditions as specified in clause **13**

3.7
freezing conditions

conditions in which the outside air temperature is below – 3 °C (26,6 °F) and visible moisture in any form (such as fog with visibility below 1,5 km, rain, snow, sleet or ice crystals) or standing water, slush, ice or snow is present on the runway

3.8
frost

crystallized deposit formed from water vapour on surfaces which are at or below 0 °C (32 °F)

NOTE 4 This definition includes hoar-frost.

3.9
freezing fog

cloud of supercooled water droplets at freezing point that form a deposit of ice on objects in cold weather conditions

3.10
snow

precipitation in the form of small ice crystals or flakes

[1)] To be published.

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3.11
freezing rain

water condensed from atmospheric vapour falling to earth in supercooled drops, forming an ice cap on objects

3.12
rain or high humidity on cold soaked wing

water droplets from a rainfall forming an ice topping on the wing upper surface, when the temperature of the aircraft wing surface is at or below 0 °C (32 °F)

4 Abbreviations

OAT: outside air temperature.

FP: freezing point.

5 General

The various local rules governing aircraft cold weather operations are very specific and shall be strictly adhered to.

A pilot shall not take off in an aeroplane that has:

a) frost, snow or ice adhering to any propeller, windshield or power plant installation or to air-speed, altimeter, rate of climb or flight altitude instrument systems;

b) snow or ice adhering to the wings or stabilizing or control surfaces or any frost adhering to the upper surfaces of wings or stabilizing or control surfaces.

6 Staff training and qualification

Flight safety can be jeopardized if de-icing and/or anti-icing is improperly performed. Therefore the de-icing/anti-icing procedure shall be carried out exclusively by qualified and trained personnel.

6.1 Training for crews

Both initial and recurrent training for flight crew and ground crew shall be conducted.

6.2 Subjects to be covered in training

Training shall cover the following subjects

a) effects of frost, ice and snow on aircraft performance;

b) basic characteristics of aircraft de-icing/anti-icing fluids;

c) general techniques for removing deposits of frost, ice and snow from aircraft surfaces and for anti-icing;

d) de-icing/anti-icing procedures in general and also in consideration of specific measures to be performed for different aircraft types;

e) quality control procedures;

f) vehicle operating procedures;

g) safety precautions;

h) emergency procedures;

i) use of holdover time tables.

6.3 Records

Records of personnel training and qualifications shall be maintained.

6.4 Training operation

Training shall include actual operation of de-icing/anti-icing vehicles.

7 Fluid handling

De-icing/anti-icing fluid is a chemical product with environmental impact. During fluid handling, avoid any unnecessary spillage and comply with local environmental and health laws and the manufacturer's safety data sheet.

Products from different suppliers should not be mixed and need extra qualification testing.

NOTE 5 Slippery conditions can exist on the ground or equipment following the de-icing/anti-icing procedure. Caution should be exercised, particularly under low humidity or non-precipitating weather conditions due to increased slipperiness.

7.1 Storage

7.1.1 Tanks dedicated to the storage of de-icing/anti-icing fluids shall be used.

7.1.2 Storage tanks shall be of a material of construction compatible with the de-icing/anti-icing fluid, as specified by the fluid manufacturer.

7.1.3 Tanks shall be conspicuously labelled to avoid contamination.

7.1.4 Tanks shall be inspected annually for corrosion and/or contamination. If corrosion or contamination is evident, tanks shall be maintained to standard or replaced. To prevent corrosion at the liquid/vapour interface and in the vapour space, a high liquid level in the tanks is recommended.

7.1.5 The storage temperature limits shall comply with the manufacturer's guidelines.

7.1.6 The stored fluid shall be checked routinely to insure that no degradation/contamination has taken place.

7.2 Pumping

De-icing/anti-icing fluids can show degradation caused by excessive mechanical shearing. Therefore only compatible pumps and spraying nozzles shall be used. The design of the pumping systems shall be in accordance with the fluid manufacturer's recommendations.

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7.3 Transfer lines

7.3.1 Dedicated transfer lines shall be conspicuously labelled to prevent contamination and shall be compatible with the de-icing/anti-icing fluids to be transferred.

7.3.2 An inline filter, constructed according to the fluid manufacturer's recommendations, should be used to remove any solid contaminant.

7.4 Heating

De-icing/anti-icing fluids shall be heated according to the fluid manufacturer's guidelines. The integrity of the fluid following heating shall be checked periodically.

7.5 Application

7.5.1 Application equipment shall be cleaned thoroughly before being initially filled with de-icing/anti-icing fluid in order to prevent fluid contamination.

7.5.2 De-icing/anti-icing fluid in trucks shall not be heated in confined or poorly ventilated areas such as hangars.

7.5.3 The integrity of the fluid at the spray nozzle shall be checked periodically.

8 Procedures

These procedures specify the recommended methods for de-icing and anti-icing of aircraft on the ground to provide an aerodynamically clean aircraft.

When aircraft surfaces are contaminated by frozen moisture, they shall be de-iced prior to dispatch. When freezing precipitation exists and there is a risk of precipitation adhering to the surface at the time of dispatch, aircraft surfaces shall be anti-iced. If both anti-icing and de-icing are required, the procedure may be performed in one or two steps (see **3.5**). The selection of a one- or two-step process depends upon weather conditions, available equipment, available fluids and the holdover time to be achieved. If a one step procedure is used, then both **8.1** and **8.2** apply.

For guidance regarding fluid limitations, see **8.3.1**.

NOTE 6 Where holdover time is critical, a two-step procedure using undiluted fluid should always be considered for the second step.

8.1 De-icing

Ice, snow or frost may be removed from aircraft surfaces by heated fluids or mechanical methods. The following procedures shall be used for their removal.

8.1.1 *Requirements*

Ice, snow and frost shall be removed from aircraft surfaces prior to dispatch or prior to anti-icing.

8.1.2 *General*

For maximum effect, fluids shall be applied close to the surface of the skin to minimize heat loss.

NOTE 7 The heat in the fluid effectively melts any frost, as well as light deposits of snow 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 residue. The de-icing fluid will prevent refreezing for a period of time depending on aircraft skin and ambient temperature, the fluid used and the mixture strength.

8.1.3 *Removal of frost and light ice*

A nozzle setting giving a solid cone (coarse) spray should be used.

NOTE 8 This ensures the largest droplet pattern available, thus retaining the maximum heat in the fluid. Providing the hot fluid is applied close to the aircraft skin, a minimal amount of fluid will be required to melt the deposit.

8.1.4 *Removal of snow*

A nozzle setting sufficient to flush off deposits shall be used.

NOTE 9 The procedure 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 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, selection of high fluid flow will be found to be more effective. Under certain conditions it will be possible to use the heat, combined with the hydraulic force of the fluid spray to melt and subsequently flush off frozen deposits. However, where snow has bonded to the aircraft skin, the procedures detailed in **8.1.5** 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 worst of the snow manually before attempting a normal de-icing procedure.

8.1.5 *Removal of ice*

Heated fluid shall be used to break the ice bond. The method makes use of the high thermal conductivity of the metal skin.

A jet of hot fluid is directed at close range onto one spot, until the bare metal is just exposed. This bare metal will then transmit the heat laterally in all directions raising the temperature above the freezing point thereby breaking the adhesion of the frozen mass to the aircraft surface. By repeating this procedure a number of times, the adhesion of a large area of frozen snow or glazed ice can be broken. The deposits can then be flushed off with either a low or high flow, depending on the amount of the deposit.

8.1.6 *General de-icing fluid application strategy*

For effective removal of snow and ice, the following techniques shall be adopted. Certain aircraft can require unique procedures to accommodate design differences.

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8.1.6.1 *Wings/tailplane*

Spray from the tip inboard to the root from the highest point of the surface camber to the lowest. However, aircraft configurations and local conditions can dictate a different procedure.

8.1.6.2 *Vertical surfaces*

Start at the top and work down.

8.1.6.3 *Fuselage*

Spray along the top centre-line and then outboard.

8.1.6.4 *Landing gear and wheel bays*

The application of de-icing fluid in this area shall be kept to a minimum. De-icing fluid shall not be sprayed directly on hot wheels and brakes.

NOTE 10 Accumulations such as blown snow can be removed mechanically. However, where deposits have bonded to surfaces, they can be removed by the application of hot air or by spraying with hot de-icing fluids.

8.1.6.5 *Engines*

Deposits of snow should be removed mechanically from engine intakes prior to departure. Any frozen deposits that have bonded to either the lower surface of the intake or the fan blades may be removed by hot air or other means recommended by the engine manufacturer.

8.2 Anti-icing

Ice, snow or frost will, for a period of time, be prevented from adhering to or accumulating on aircraft surfaces by the application of anti-icing fluids. The following procedures shall be adopted when using anti-icing fluids.

8.2.1 ***Required usage***

Anti-icing fluid shall be applied to the aircraft surfaces when freezing rain, snow or other freezing precipitation is falling and adhering at the time of aircraft dispatch.

8.2.2 ***Recommended usage***

Anti-icing fluid may be applied to aircraft surfaces at the time of arrival (preferably before unloading begins) on short turnarounds when snow or freezing rain is falling.

NOTE 11 This will minimize the ice accumulation problem prior to departure and often makes subsequent de-icing unnecessary.

On receipt of a frost, snow, freezing rain or freezing fog warning from the local meteorological service, anti-icing fluid may be applied to aircraft surfaces prior to the start of freezing precipitation.

NOTE 12 This will minimize the possibility of snow and ice bonding or reduce the accumulation of frozen precipitation on aircraft surfaces and facilitate subsequent de-icing.

8.2.3 ***General***

For effective anti-icing, a thin, even film of undiluted ISO type I or type II fluid shall be applied over the prescribed aircraft surfaces which are clean or which have been de-iced. For maximum anti-icing protection, undiluted, unheated ISO type II fluid should be used.

The high fluid pressures and flow rates normally associated with de-icing are not required for this operation and, where possible, pump speeds should be reduced accordingly. The nozzle of the spray gun should be adjusted to give a medium spray.

NOTE 13 ISO type I fluids have limited effectiveness when used for anti-icing purposes. Little benefit is gained from the minimal holdover time generated.

8.2.4 ***Anti-icing fluid application strategy***

The process should be continuous and as short as possible. Anti-icing should be carried out as near to the departure time as operationally possible in order to maintain maximum holdover time. The anti-icing fluid shall be distributed uniformly over all surfaces to which it is applied. In order to control the uniformity, all horizontal aircraft surfaces shall be visually checked during application of the fluid. The correct amount is indicated by fluid just beginning to drop off the leading and trailing edges.

The most effective results are obtained by commencing on the highest part of the wing section and covering from there towards the leading and trailing edges. On vertical surfaces, start at the top and work down.

The following surfaces shall be protected:

a) wing upper surface;

b) tailplane upper surface;

c) vertical stabilizer and rudder;

d) fuselage upper surfaces depending upon the amount and type of precipitation (especially important on centre-line engined aircrafts).

8.3 Limits and precautions

8.3.1 ***Fluid related limits***

8.3.1.1 *Temperature limits*

When performing two-step de-icing/anti-icing, the freezing point of the fluid used for the first step shall not be more than 3 °C (5,4 °F) above ambient temperature. (See also Table 1 and Table 2.)

8.3.1.1.1 *ISO type I fluids*

The freezing point of the ISO type I fluid mixture used for either one-step de-icing/anti-icing or as a second step in the two-step operation shall be at least 10 °C (18 °F) below the ambient temperature.

Undiluted ISO type I fluids shall meet aerodynamic and freezing point requirements.

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8.3.1.1.2 *ISO type II fluids*

ISO type II fluids used as de-icing/anti-icing agents have a lower temperature application limit of – 25 °C (– 13 °F). The application limit may be lower, provided a 7 °C (12,6 °F) buffer is maintained between the freezing point of the neat fluid and outside air temperature. In no case shall this temperature be lower than the lowest operational use temperature as defined by the aerodynamic acceptance test.

8.3.1.2 *Application limits*

An aircraft that has been anti-iced with undiluted ISO type II fluid shall not receive a further coating of anti-icing fluid directly on top of the existing film under any circumstances. If it is necessary for an aircraft to be reprotected prior to the next flight, the external surfaces shall first be de-iced with a hot fluid mix before a further application of anti-icing fluid is made. (See also Table 3 and Table 4.)

8.3.2 ***Aircraft related limits***

The application of de-icing/anti-icing fluid shall be in accordance with the guidelines of the air-frame/engine manufacturers.

8.3.3 ***Procedure precautions***

8.3.3.1 One-step de-icing/anti-icing is performed with an anti-icing fluid. The fluid used to de-ice the aircraft remains on aircraft surfaces to provide limited anti-ice capability. The correct fluid concentration shall be chosen with regard to desired holdover time and is dictated by outside air temperature and weather conditions. See Table 1 and Table 2.

CAUTION — Aircraft skin temperature and outside air temperature can differ.

8.3.3.2 Two-step de-icing/anti-icing: the first step is performed with de-icing fluid. The correct fluid shall be chosen with regard to ambient temperature. After de-icing, a separate overspray of anti-icing fluid shall be applied to protect the relevant surfaces thus providing maximum possible anti-ice capability. The second step is performed with anti-icing fluid. The correct fluid concentration shall be chosen with regard to desired holdover time and is dictated by outside air temperature and weather conditions. See Table 1 and Table 2.

CAUTION — Aircraft skin temperature and outside air temperature can differ.

The second step shall be performed before first step fluid freezes (typically within 3 min), if necessary area by area. If freezing has occurred on the critical areas of the aircraft, the first step shall be repeated.

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

8.3.3.4 Aircraft shall be treated symmetrically, that is, left-hand and right-hand side shall receive the same and complete treatment.

NOTE 14 Aerodynamic problems could result if this requirement is not met.

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

8.3.3.6 Engines are normally shut down during de-icing operations, but if they are running, main engines shall be slow running and air conditioning and/or auxiliary power unit (APU) air selected OFF.

8.3.3.7 De-icing/anti-icing fluids shall not be sprayed directly onto hot brakes, wheels, exhausts or thrust reversers.

8.3.3.8 De-icing/anti-icing fluid shall not be directed into the orifices of pitot heads, static vents or directly onto airstream direction detectors probes/angle of attack airflow sensors.

8.3.3.9 All reasonable precautions shall be taken to minimize fluid entry into engines, other intakes/outlets and control surface cavities.

8.3.3.10 Fluids shall not be directed onto flight deck or cabin windows as this can cause cracking of acrylics or penetration of the window sealing.

8.3.3.11 All doors and windows shall be closed to prevent:

a) galley floor areas being contaminated with slippery de-icing fluids;

b) upholstery becoming soiled.

8.3.3.12 During the application of anti-icing/de-icing fluids, doors shall not be closed until all ice or snow has been removed from the surrounding area.

8.3.3.13 Any forward area from which fluid can blow back onto windscreens during taxi or subsequent take-off shall be free of fluid residues prior to departure.

8.3.3.14 If ISO type II fluids are used, all traces of the fluid on flight deck windows shall be removed prior to departure, particular attention being paid to windows fitted with wipers.

De-icing/anti-icing fluid may be removed by rinsing with clear water and a soft cloth. Windscreen wipers shall not be used for this purpose.

8.3.3.15 Landing gear and wheel bays shall be kept free from build-up of slush, ice or accumulations of blown snow.

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8.3.3.16 When removing ice, snow or slush from aircraft surfaces care shall be taken to prevent it entering and accumulating in auxiliary intakes or control surface hinge areas, i.e. remove snow from wings and stabilizer surfaces forward towards the leading edge and remove from ailerons and elevators back towards the trailing edge.

8.3.3.17 Ice can build up on aircraft surfaces when descending through dense clouds or precipitation during an approach. When ground temperatures at the destination are low, it is possible for flaps to be retracted and for accumulations of ice to remain undectected between stationary and moveable surfaces. It is therefore important that these areas are checked prior to departure and any frozen deposits are removed.

8.3.3.18 Under freezing fog conditions, the rear side of the fan blades shall be checked for ice build-up prior to start-up. Any deposits discovered shall be removed by directing air from a low flow hot air source, such as a cabin heater, onto the affected areas.

8.3.3.19 A flight control check should be considered according to aircraft type (see relevant manuals). This check should be performed after de-icing/anti-icing.

8.3.4 ***Clear ice precautions***

8.3.4.1 Clear ice can form on aircraft surfaces, below a layer of snow or slush. It is therefore important that surfaces are closely inspected following each de-icing operation, in order to ensure that all deposits have been removed.

8.3.4.2 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 to this type of build-up when:

a) wing temperatures remain well below 0 °C (32 °F) during the turnaround/transit;

b) ambient temperatures between – 2 °C and + 10 °C (28,4 °F and 50 °F) are experienced;

NOTE 15 Clear ice can form at other temperatures if conditions a) and c) exist.

c) precipitation occurs while the aircraft is on the ground.

This type of ice formation is extremely difficult to detect. Therefore when the above conditions prevail, or when there is otherwise any doubt whether clear ice has formed, a close inspection shall be made immediately prior to departure, in order to ensure that all frozen deposits have in fact been removed.

NOTE 16 This type of build-up normally occurs at low wing temperatures and when large quantities of cold fuel remain in wing tanks during the turnaround/transit and any subsequent refuelling is insufficient to cause a significant increase in fuel temperature.

9 General aircraft requirements after de-icing/anti-icing

Following the de-icing/anti-icing procedures and prior to take-off, the critical aircraft surface shall be clean of all frost, ice and snow accumulations in accordance with the following requirements.

9.1 Wings, tail and control surfaces

Wings, tail and control surfaces shall be free of ice, snow and frost except that a coating of frost may be present on wing lower surfaces in areas coldsoaked by fuel between forward and aft spars in accordance with the aircraft manufacturer's published manuals.

9.2 Pitot heads and static ports

Pitot heads and static ports shall be clear of ice, frost, snow and fluid residues.

9.3 Engine inlets

Engine inlets shall be clear of internal ice and snow and shall be fan free to rotate.

9.4 Air conditioning inlets and exits

Air conditioning inlets and exits shall be clear of ice, frost and snow. Outflow valves shall be clear and un-obstructed.

9.5 Landing gear and landing gear doors

Landing gear and landing gear doors shall be unobstructed and clear of ice, frost and snow.

9.6 Fuel tank vents

Fuel tank vents shall be clear of ice, frost and snow.

9.7 Fuselage

Fuselage shall be clear of ice and snow. Adhering frost may be present in accordance with the aircraft manufacturer's manuals.

9.8 Flight control check

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

10 Final inspection before aircraft dispatch

An aircraft shall not be dispatched for departure under icing conditions or after a de-icing/anti-icing operation until the aircraft has received a final inspection by a responsible authorized person.

The inspection shall visually cover all critical parts of the aircraft and be performed from points offering sufficient visibility of these parts (e.g. from the de-icer itself or another elevated piece of equipment).

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The authorized person shall indicate the inspection results in accordance with clause **9** by documentation, if applicable, according to airline or local airworthiness authority requirements.

11 Pre-take-off inspection

When freezing precipitation exists, aerodynamic surfaces shall be checked just prior to the aircraft taking the active runway or initiating the take-off roll in order to confirm that they are free of all forms of frost, ice and snow. This is particularly important when severe conditions are experienced or the published holdover times have either been exceeded or are about to run out. When deposits are in evidence, the de-icing operation shall be repeated.

If aircraft surfaces cannot adequately be inspected from inside the aircraft, it is desirable to provide a means of assisting the flight crew in determining the condition of the aircraft. The inspection should be conducted as near as practical to the beginning of the departure runway.

NOTE 17 When airport configuration allows, it is desirable to carry out de-icing/anti-icing and inspection of aircraft near the beginning of departure runways to minimize the time interval between aircraft de-icing/anti-icing and take-off under conditions of freezing precipitation.

12 Flight crew information

12.1 De-icing/anti-icing operation

An aircraft shall not be dispatched for departure after a de-icing/anti-icing operation until the flight crew has been notified of the type of de-icing/anti-icing operation performed.

The notification shall include the results of the final inspection by qualified personnel, indicating that the aircraft critical parts are free of ice, frost and snow.

In addition, the notification shall include the necessary de-icing/anti-icing codes as specified in **12.2** to allow the flight crew to estimate the holdover time to be expected under the prevailing weather conditions.

12.2 De-icing/anti-icing codes

The following information shall be recorded concerning the last step of the de-icing/anti-icing procedure:

a) the ISO fluid type, i.e. I for ISO type I and II for ISO type II;

b) the concentration of fluid within the fluid/water mixture, expressed as a percentage by volume;

c) the local time (hours/minutes) at the beginning of the final de-icing/anti-icing step;

d) the date (written day, month, year).

EXAMPLE
A de-icing/anti-icing procedure whose last step is the use of a mixture of 75 % of an ISO type II fluid and 25 % water commencing at 13:35 local time on 20 April 1992 is recorded as follows:

II 75 1335 20 April 1992

The first three elements of the code shall be communicated to the flight crew. The date may optionally be communicated.

13 Holdover time

Holdover time is achieved by anti-icing fluids remaining on the aircraft surfaces.

Due to its properties, ISO type I fluid forms a thin liquid wetting film, which gives a rather limited holdover time, depending on the weather conditions.

ISO type II fluid contains a pseudoplastic 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.

Table 3 and Table 4 give indications of approximate holdover times that could reasonably be expected under conditions of precipitation. However, due to the many variables that can influence holdover times, these times should not be considered as minimum or maximum as the actual time of protection can be extended or reduced, depending upon the particular conditions existing at the time.

CAUTION — The times of protection represented in these tables are for general information purposes only. The time of protection will be shortened in heavy weather conditions. High wind velocity and jet blast can cause a degradation of the protective film. If these conditions occur, the time of protection can be shortened considerably. This is also the case when the fuel temperature is significantly lower than outside air temperature. Therefore the indicated times should be used only in conjunction with a visual pre-take-off inspection.

NOTE 18 Ongoing testing during winter season operations will allow holdover times to be further defined.

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Table 1 — Guideline for the application of ISO type I fluid mixtures (minimum concentrations)

<table>
<tr><th rowspan="2">Outside air temperature
OAT
°C (°F)</th><th>One-step procedure</th><th colspan="2">Two-step procedure</th></tr>
<tr><th>De-icing/anti-icing</th><th>First step: De-icing</th><th>Second step: Anti-icing[a]</th></tr>
<tr><td>OAT ⩾ – 3
(OAT ⩾ 26,6)</td><td rowspan="2">FP of heated[b] fluid mixture should be at least 10 °C (18 °F) below OAT</td><td>Water heated to 60 °C (140 °F) minimum at the nozzle or a heated mix of fluid and water</td><td rowspan="2">FP of fluid mixture shall be at least 10 °C (18 °F) below actual OAT</td></tr>
<tr><td>OAT < – 3
(OAT < 26,6)</td><td>FP of heated fluid mixture shall not be more than 3 °C (5,4 °F) above actual OAT)</td></tr>
<tr><td colspan="4">NOTE 1 The responsibility for the application of these data remains with the user.
NOTE 2 For heated fluids, a fluid temperature not less than 60 °C (140 °F) at the nozzle is desirable.
[a] To be applied before first step fluid freezes, typically within 3 min (see 8.3.3.2).
[b] Clean aircraft may be anti-iced with cold fluid.</td></tr>
</table>

Table 2 — Guideline for the application of ISO type II fluid mixtures (minimum concentrations)

Concentrations in % (*V/V*)

<table>
<tr><th rowspan="3">Outside air temperature
OAT
°C (°F)</th><th colspan="3">Concentration of nest fluid water</th></tr>
<tr><th rowspan="2">One-step procedure
De-icing/anti-icing</th><th colspan="2">Two-step procedure</th></tr>
<tr><th>First step: De-icing</th><th>Second step: Anti-icing[a]</th></tr>
<tr><td>OAT ⩾ – 3
(OAT ⩾ 26,6)</td><td rowspan="2">50/50
Heated ISO type II</td><td>Water heated to 60 °C (140 °F) minimum at the nozzle or heated mix of ISO type I or II fluid with water</td><td rowspan="2">50/50
ISO type II</td></tr>
<tr><td>– 7 ⩽ OAT < – 3
(19,4 ⩽ OAT < 26,6)</td><td rowspan="3">Heated 50/50 or suitable mix of ISO type I with FP not more than 3 °C (5,4 °F) above actual OAT</td></tr>
<tr><td>– 14 ⩽ OAT < – 7
(6,8 ⩽ OAT < 19,4)</td><td>75/25
Heated ISO type II</td><td>75/25
ISO type II</td></tr>
<tr><td>– 17 ⩽ OAT < – 14
(1,4 ⩽ OAT < 6,8)</td><td rowspan="2">—</td><td rowspan="2">100/0
ISO type II</td></tr>
<tr><td>– 25 ⩽ OAT < – 17
(– 13 ⩽ OAT < 1,4)</td><td>Heated 75/25 or suitable mix of ISO type I with FP not more than 3 °C (5,4 °F) above OAT</td></tr>
<tr><td>OAT < – 25
(OAT < – 13)</td><td colspan="3">ISO type II may be used for anti-icing below – 25 °C (– 13 °F) provided that a 7 °C (12,6 °F) buffer is maintained (see 8.3.1.1.2). Consider use of ISO type I where ISO type II cannot be used (see Table 1).</td></tr>
<tr><td colspan="4">NOTE 1 For heated fluids, a fluid temperature not less than 60 °C (140 °F) at the nozzle is desirable.
NOTE 2 For overnight protection, see 8.2.3.
[a] To be applied before first step fluid freezes, typically within 3 min (see 8.3.3.2).</td></tr>
</table>

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Table 3 — Approximate holdover times achieved by ISO type I fluid mixtures

Times in minutes

Outside air temperature OAT °C (°F)	Weather conditions				
	Frost	Freezing fog	Snow	Freezing rain	Rain on cold soaked wing
OAT ⩾ 0 (OAT ⩾ 32)	18 to 45	12 to 30	6 to 15	2 to 5	6 to 15
– 7 ⩽ OAT < 0 (19,4 ⩽ OAT < 32)	18 to 45	6 to 15	6 to 15	1 to 3	—
OAT < – 7 (OAT < 19,4)	12 to 30	6 to 15	6 to 15		

NOTE 1 The responsibility for the application of these data remains with the user. This table should only be used in conjunction with this International Standard.
NOTE 2 Freezing point of an ISO type I fluid mixture shall be at least 10 °C (18 °F) below outside air temperature.

Table 4 — Approximate holdover times achieved by ISO type II fluid mixtures

Outside air temperature OAT °C (°F)	ISO type II fluid mixture concentration neat fluid water % (*V*/*V*)	Weather conditions				
		Frost[a]	Freezing fog	Snow	Freezing rain	Rain on cold soaked wing
OAT ⩾ 0 (OAT ⩾ 32)	100/0 75/25 50/50	12 h 6 h 4 h	1 h 15 min to 3 h 50 min to 2 h 35 min to 1 h 30 min	25 min to 1 h 20 min to 45 min 15 min to 30 min	8 min to 20 min 4 min to 10 min 2 min to 5 min	24 min to 1 h 18 min to 45 min 12 min to 30 min
– 7 ⩽ OAT < 0 (19,4 ⩽ OAT < 32)	100/0 75/25 50/50	8 h 5 h 3 h	35 min to 1 h 30 min 25 min to 1 h 20 min to 45 min	20 min to 45 min 15 min to 30 min 5 min to 15 min	8 min to 20 min 4 min to 10 min 1 min to 3 min	—
– 14 ⩽ OAT < – 7 (6,8 ⩽ OAT < 19,4)	100/0 75/25	8 h 5 h	35 min to 1 h 30 min 25 min to 1 h	20 min to 45 min 15 min to 30 min	—	—
– 25 ⩽ OAT < – 14 (– 13 ⩽ OAT < 6,8)	100/0	8 h	35 min to 1 h 30 min	20 min to 45 min	—	—
OAT < – 25 (OAT < – 13)	100/0[b]	ISO type II fluid may be used for anti-icing below – 25 °C (– 13 °F) provided that a 7 °C (12,6 °F) buffer is maintained. Consider use of ISO type I fluid where ISO type II cannot be used (see Table 3).				

NOTE 1 The responsibility for the application of these data remains with the user. This table should only be used in conjunction with this International Standard.

[a] For maintenance purpose.

[b] If 7 °C (12,6 °F) buffer is maintained (see **8.3.1.1.2**).

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List of references

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