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

Aéronautique et espace — Méthodes de dégivrage et d'antigivrage des aéronefs à l'aide de liquides

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11076 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This third edition cancels and replaces the second edition (ISO 11076:2000), which has been technically revised to update the annexes.

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Annexes A and B form a normative part of this International Standard.

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Annexes A and B of this International Standard provide guidelines for the application of different types of de-icing/anti-icing fluids as a function of outside air temperature and of weather conditions. This data requires frequent updating. ISO/TC 20/SC 9 has agreed to delegating this task under its own guidance to an ISO Maintenance Agency. The ISO Maintenance Agency designated for this task is:

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

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.

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

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The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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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 11078:1994, *Aerospace — Aircraft de-icing/anti-icing non-Newtonian fluids, ISO type II*.

3 Terms and definitions

3.1
de-icing
procedure by which frost, ice, slush, or snow is removed from an aircraft in order to provide clean surfaces

3.2
de-icing fluid
defined as one of the following:

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, III or IV fluids in accordance with ISO 11078;

e) mixture of water and ISO type II, III or IV fluids

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

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3.3
anti-icing
precautionary procedure which provides protection against the formation of frost or ice and accumulation of snow or slush on treated surfaces of the aircraft for a limited period of time (holdover time)

3.4
anti-icing fluid
defined as one of the following:

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

b) mixture of water and ISO type I fluid;

c) ISO type II, III or IV fluids in accordance with ISO 11078;

d) mixture of water and ISO type II, III or IV fluids

NOTE Anti-icing fluid is normally applied unheated on clean aircraft surfaces but may be applied heated.

3.5
de-icing/anti-icing
combination of the procedures described in 3.1 and 3.3

NOTE It may be performed in one or two steps.

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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

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3.7
freezing conditions
conditions in which the outside air temperature is below +3°C (37,4 °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/hoarfrost
ice crystals that form from ice saturated air at temperatures below 0 °C (32 °F) by direct sublimation on the ground or other exposed objects

3.9
freezing fog
suspension of numerous minute water droplets which freezes upon impact with ground or other exposed objects, generally reducing the horizontal visibility at the earth's surface to less than 1 km (5/8 mile)

3.10
snow
precipitation of ice crystals, most of which are branched, star-shaped or mixed with unbranched crystals and at temperatures higher than −5 °C (23 °F), the crystals are generally agglomerated into snowflakes

3.11
freezing drizzle
fairly uniform precipitation composed exclusively of fine drops [diameter less than 0,5 mm (0,02 in)] very close together which freezes upon impact with the ground or other exposed objects

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3.12
light freezing rain
precipitation of liquid water particles which freezes upon impact with exposed objects, in the form of drops of more than 0,5 mm (0,02 in) which, in contrast to drizzle, are widely separated

NOTE Measured intensity of liquid water particles are up to 2,5 mm/h (0,10 inch/h) or 25 g/dm^2/h with a maximum of 2,5 mm (0,10 in) in 6 min.

3.13
rain or high humidity (on cold-soaked wing)
water forming ice or frost on the wing surface, when the temperature of the aircraft wing surface is at or below 0 °C (32 °F)

3.14
sleet
precipitation in the form of a mixture of rain and snow

NOTE Operation in light sleet is treated as light freezing rain.

3.15
slush
snow or ice that has been reduced to a soft watery mixture by rain, warm temperature and/or chemical treatment

3.16
check
examination of an item against a relevant standard by a trained and qualified person

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4 Abbreviated terms

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OAT outside air temperature

FP freezing point

5 General requirements

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

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

b) snow, slush 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 Requirements for staff training and qualifications

6.1 Personnel qualifications

De-icing/anti-icing procedures shall be carried out exclusively by trained and qualified personnel.

6.2 Training for crews

Both initial and annual recurrent training for flight crew and ground crew shall be conducted to ensure that all such crews obtain and retain a thorough knowledge of aircraft de-icing/anti-icing policies and procedures, including new procedures and lessons learned.

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6.3 Subjects to be covered in training

Training shall include the following items as a minimum:

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

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

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

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

e) types of checks required;

f) de-icing/anti-icing equipment operating procedures, including actual operation of equipment;

g) safety precautions;

h) emergency procedures;

i) fluid application and limitations of holdover time tables;

j) de-icing/anti-icing codes and communication procedures;

k) special provisions and procedures for contract de-icing/anti-icing (if applicable);

l) environmental considerations, for example where to de-ice, spill reporting, hazardous waste control;

m) new procedures and development, lessons learned from previous winters.

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6.4 Records

Records of personnel training and qualifications shall be maintained for proof of qualification.

7 Requirements for fluid handling

7.1 Environment

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.

7.2 Mixing of different products

Different products shall not be mixed without additional qualification testing.

7.3 Storage

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

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

7.3.2 Tanks shall be conspicuously labelled to avoid contamination.

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7.3.3 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.

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

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

7.4 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.

7.5 Transfer lines

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

7.6 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.

7.7 Application

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

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

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

8 Procedures

8.1 Need for de-icing/anti-icing

The following 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 de-icing and anti-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 8.2 and 8.3 apply.

NOTE 1 Slippery conditions can exist on the ground or equipment following the de-icing/anti-icing procedures. Caution should be exercised, particularly under low humidity or non-precipitating weather conditions due to increased slipperiness.

For guidance regarding fluid limitations, see 8.3.1.

NOTE 2 Where holdover time is critical, a two-step procedure using undiluted type II, III or IV fluid for the second step should always be considered.

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8.2 De-icing

8.2.1 General

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

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

NOTE 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 residue. The de-icing fluid will prevent refreezing for a period of time depending on aircraft skin and ambient temperature, the fluid used, the mixture strength and the weather.

8.2.2 Requirements

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

8.2.3 Removal of frost and light ice

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

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

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8.2.4 Removal of snow

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

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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 8.2.5 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.

8.2.5 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.

8.2.6 De-icing fluid application strategy

8.2.6.1 General

For effective removal of snow and ice, the following techniques shall be adopted.

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8.2.6.2 Aircraft unique procedures

Certain aircraft can require unique procedures to accommodate design differences. See manufacturer's instructions.

8.2.6.3 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.

8.2.6.4 Vertical surfaces

Start at the top and work down.

8.2.6.5 Fuselage

Spray along the top centre-line and then outboard.

8.2.6.6 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 onto wheels and brakes.

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.

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8.2.6.7 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.

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8.2.7 De-icing location

De-icing/anti-icing near the beginning of the departure runway provides the minimum interval between de-icing/anti-icing and takeoff.

8.3 Anti-icing

8.3.1 General

Ice, snow, slush, 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.

For effective anti-icing, an even film of fluid is required over the prescribed aircraft surfaces which are clean (free of frozen deposits). For longer anti-icing protection, undiluted, unheated ISO type II, III or IV fluids 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 provide a medium spray.

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

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