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AIRCRAFT ANTI-ICING AND DE-ICING

1 INTRODUCTION

1.1 The purpose of this AIC is to supplement the regulatory requirements in accordance with ICAO Annex 6 Part 1 Chapter 4 paras 4.3.5.3 and 4.3.5.4, Chapter 6 para 6.8 and Manual of Aircraft Ground De/Anti-icing Operations (Doc 9640-AN/940 with regard to aeroplanes in icing conditions. This will enable operator to formulate operational procedure when operating in icing conditions.

2 DEFINITIONS

2.1 De-Icing. A procedure by which frost, ice, slush and snow is removed from an aircraft in order to provide uncontaminated surfaces.

2.2 Anti-Icing. A precautionary procedure that provides protection against the formation of frost or ice and accumulations of snow on treated surfaces of the aircraft for a limited period of time (holdover time).

2.3 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 all weather conditions.

3 REQUIREMENTS

3.1 The following are to be included in the procedures for icing conditions :

3.1.1 No person may dispatch or release an aircraft, continue to operate an aircraft en-route, or land an aircraft when in the opinion of the pilot in command that icing conditions are expected or met, that might adversely affect the safety of the flight.

3.1.2 No person may takeoff an aircraft when frost, ice, or snow is adhering to the wings, control surfaces, propellers, engine inlets, or other critical surfaces of the aircraft or when the takeoff would not be in compliance with paragraph 3.1.3 of this section. Takeoffs with frost under the wing in the area of the fuel tanks may be allowed provided it meets all the requirements reflected in the operations manual which has been approved by DCA.

3.1.3 Except as provided in paragraph d) of this section, no person may dispatch, release, or takeoff an aircraft any time when the conditions are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft, unless the certificate holder has an approved ground de-icing/anti-icing procedures in its operations manual and unless the dispatch, release, and takeoff comply with that procedure. The approved ground de-icing/anti-icing procedures must include at least the following items:

a. A detailed description of:-

- i. How the certificate holder determines that conditions are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft and that ground de-icing/anti-icing operational procedures must be in effect;
- ii. Who is responsible for deciding that ground de-icing/anti-icing operational procedures must be in effect;
- iii. The procedures for implementing ground de-icing/anti-icing operational procedures;
- iv. The specific duties and responsibilities of each operational position or group responsible for getting the aircraft safely airborne while ground de-icing/anti-icing operational procedures are in effect.

b. Initial and annual recurrent ground training and testing for flight crewmembers and qualification for all other affected personnel (e.g., ground crews, contract personnel) concerning the specific requirements of the approved procedures and each person's responsibilities and duties under the approved procedures, specifically covering the following areas:

- i. The use of holdover times.
- ii. Aircraft de-icing/anti-icing procedures, including inspection and check procedures and responsibilities.
- iii. Communications procedures.
- iv. Aircraft surface contamination (i.e., adherence of frost, ice, or snow) and critical area identification, and how contamination adversely affects aircraft performance and flight characteristics.
- v. Types and characteristics of de-icing/anti-icing fluids.
- vi. Cold weather pre-flight inspection procedures.
- vii. Techniques for recognizing contamination on the aircraft.

c. The certificate holder's holdover timetables and the procedures for the use of these tables by the certificate holder's personnel. Holdover time begins when the final application of de-icing/anti-icing fluid commences and expires when the de-icing/anti-icing fluid applied to the aircraft loses its effectiveness. The holdover times must be supported by data acceptable to the DCA. The certificate holder's procedures must provide for flight crewmembers to increase or decrease the determined holdover time in changing conditions. The procedures must provide that takeoff after exceeding any maximum holdover time in the certificate holder's holdover timetable is permitted only when at least one of the following conditions exists:

- i. A pre-takeoff contamination check, as defined in paragraph d) of this section, determines that the wings, control surfaces, and other critical surfaces, as defined in the certificate holder's program, are free of frost, ice, or snow.
- ii. It is otherwise determined by an alternate procedure approved by DCA is in accordance with the certificate holder's approved procedures that the wings, control surfaces, and other critical surfaces, are free of frost, ice, or snow.
- iii. The wings, control surfaces, and other critical surfaces are re-de-iced and a new holdover time is determined.

d. Aircraft de-icing/anti-icing procedures and responsibilities, pre-takeoff check procedures and responsibilities, and pre-takeoff contamination check procedures and responsibilities. A pre-takeoff check is a check of the aircraft's wings or representative aircraft surfaces for frost, ice, or snow within the aircraft's holdover time. A pre-takeoff contamination check is a check to make sure the wings, control surfaces, and other critical surfaces, as defined in the certificate holder's procedures, are free of frost, ice, and snow. It must be conducted within five minutes prior to beginning takeoff. This check must be accomplished from outside the aircraft unless the procedures specifies otherwise.

e. A certificate holder may continue to operate under this section without procedures as required in paragraph c) of this section, if it includes a requirement that, any time conditions are such that frost, ice, or snow may reasonably be expected to adhere to the aircraft, no aircraft will takeoff unless it has been checked to ensure that the wings, control surfaces, and other critical surfaces are free of frost, ice, and snow. The check must occur within five minutes prior to beginning takeoff. This check must be accomplished from outside the aircraft.

4 EXAMPLE OF AN OPERATOR'S GUIDANCE ON DE-ICING / ANTI-ICING OPERATIONS

4.1 Holdover times – anti-icing/de-icing fluids

4.1.1 There are currently three main types of anti-icing/de-icing fluids:

a. ISO Type Fluid (un-thickened) (SAE AMS 1424A)

This fluid has a high glycol content and low viscosity in its concentrated form. De-icing performance of the fluid is good. However, due to low viscosity, it provides only limited anti-icing protection during freezing precipitation. It is used predominantly for removing frozen deposits from aircraft surfaces, either as the first step in a two-step operation or where precipitation has stopped. With this type of fluid no additional protection is provided by increasing the concentration of the fluid in the fluid/water mix. Type 1 fluids are usually clear.

b. ISO Type 11 F Fluid (thickened) (SAE AMS 1428A)

This fluid generally has a lower glycol content in its concentrate form than type 1 fluid due to the inclusion of a pseudo plastic thickening agent. This effectively means that when applied to the surface of an aircraft the viscosity is high, thus allowing the fluid to remain on and protect against freezing precipitation for a period of time. However, the increasing effect of the airflow over the wing during take-off roll will effectively shear the fluid, reducing its viscosity and allowing it to readily flow off the critical surfaces. With this type of fluid the holdover time can be extended by increasing the concentration of fluid in the fluid/water mix. Type 11 fluids are usually straw coloured.

c. ISO Type IV Fluid (Thickened) (SAE AMS 1428A)

This fluid is similar in both composition and operation to Type 11 fluids. However, through the use of advanced thickening systems it is able to provide more holdover time than Type 11 fluids, when used in concentrated form. As with type 11 fluids the holdover time can be extended by increasing the concentration of fluid in the fluid/water mix. Type IV fluids usually coloured green.

4.2 Guideline to holdover time

4.2.1 After a de anti-icing treatment a take-off is permitted provided the time between end of the treatment and take-off does not exceed the times mentioned in the following tables for the mentioned weather conditions.

4.2.2 Although the holdover times mentioned have been determined in a very conservative way, it should be appreciated that detrimental factors, especially when accumulating, can shorten such a time considerably, See also the following remarks which refer to the tables.

4.2.3 Remarks

- i. HEAVY SNOW and HEAVY FREEZING RAIN conditions are not incorporated in these tables; thus, a take-off under these conditions is prohibited.
- ii. High wind velocity and jet blast may cause a degradation of the protective film; as a result the holdover time will be shortened.
- iii. The anti-icing code for a two-step de-icing treatment consists of the fluid type plus an indication of the mixture that was used, eg. AE type 2/100

Type 1. Guideline to holdover times (hr/min)
Anti-icing code : AE type 1

OAT °C	Actual weather conditions				
	Frost	Freezing Fog	Snow	Freezing Rain	Rain on cold soaked wings
+0 and above	0.45	0.30	0.15	NIL	0.15
-0 to -7	0.45	0.15	0.15	NIL	XXXXXXXXXX XXXXXXXXXX
-8 and below	0.30	0.15	0.15	XXXXXXXXXX XXXXXXXXXX	XXXXXXXXXX XXXXXXXXXX

Type 2. Guideline to holdover times (hr/min)

AOC °C	Actual weather conditions					Anti-icing code: AEA type 2/100/75/50		
	Frost	Freezing Fog	Snow	Freezing Rain	Rain on cold soaked wings	100	75	50
+0 and above	↓					12.00	6.00	4.00
		↓				3.00	2.00	1.30
			↓			1.00	0.45	0.30
				↓		0.20	NIL	NIL
-0 to -7	↓					8.00	5.00	3.00
		↓				1.30	1.00	0.45
			↓			0.45	0.30	0.15
				↓		0.20	NIL	NIL

OAC °C	Actual weather conditions					Anti-icing code: AEA type 2/100/75/50		
	Frost	Freezing fog	Snow	Freezing rain	Rain on cold soaked wings	100	75	50
-8 to -14	↓			XXXXX	XXXXXXXXXX	8.00	5.00	
		↓		XXXXX	XXXXXXXXXX	1.30	1.00	
			↓	XXXXX	XXXXXXXXXX	0.45	0.30	
-15 to -25	↓			XXXXX	XXXXXXXXXX	8.00		
		↓		XXXXX	XXXXXXXXXX	1.30		
			↓	XXXXX	XXXXXXXXXX	0.45		

Note: The arrows correspond to the figures in the right-hand columns for each fluid type.