European Aviation Safety Agency

Terms of Reference

for rulemaking task RMT.0118 (25.074)

Analysis of on-ground wing contamination effect on take-off performance degradation

ISSUE 1

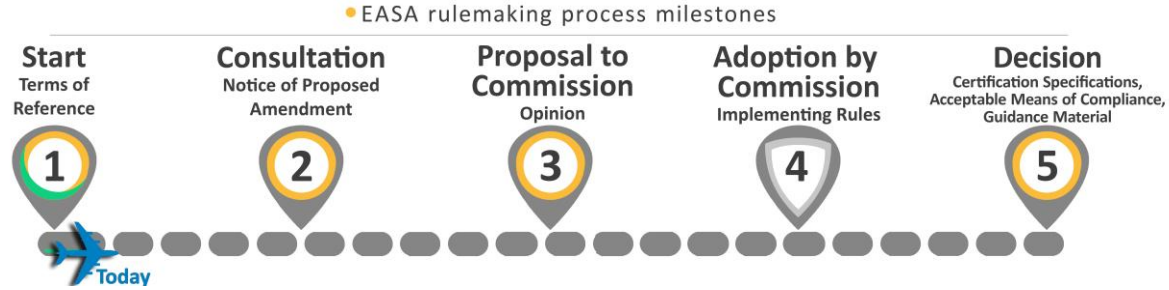
Issue/rationale

Accidents and incidents have been caused by the degradation of aircraft aerodynamic performances, reduction of safety margins and reduction of manoeuvrability/controllability due to airframe ground icing contamination or inadequate de-/anti-icing operations. EASA has received a number of safety recommendations in this respect. It is therefore proposed to review the existing certification specifications and acceptable means of compliance.

The objective of this task is to mitigate the risk of loss of control of an aeroplane (in particular during, but not limited to, the take-off phase), and the risk of runway excursion after an aborted take-off at high speeds.

To achieve this objective, it shall be considered whether there is a need for amending the existing specifications and/or to introduce new certification specifications and acceptable means of compliance into CS-23 and CS-25 requiring the applicant of a type certificate to perform an assessment of the effect of contaminated aerodynamic surfaces on aircraft performances, handling qualities, and controllability. In addition, it shall also be considered whether such requirement could be imposed on certain already certified large aeroplanes through an amendment of Part-26/CS-26.

Action area:	Ground safety		
Affected rules:	CS-25, CS-23, Part-26, CS-26,		
Affected stakeholders:	Aeroplane manufacturers and operators		
Driver:	Safety	**Rulemaking group:**	Yes
Impact assessment:	TBD with rulemaking group	**Rulemaking Procedure:**	Standard



DD.MM.20XX	2017/Q3	Opinion Part-26: 2018/Q3 Decision CS-25: 2018/Q3	2019/Q3	Decision CS-26: 2019/Q3

1. Why we need to change the rules — issue/rationale

Commission Regulation (EU) No 965/2012[1], Annex IV, CAT.OP.MPA.250(b) states that 'The commander shall only commence take-off if the aircraft is clear of any deposit that might adversely affect the performance or controllability of the aircraft, except as permitted under (a) and in accordance with the AFM'.

CAT.OP.MPA.250(a) states that 'The operator shall establish procedures to be followed when ground de-icing and anti-icing and related inspections of the aircraft are necessary to allow the safe operation of the aircraft'.

CS-25 also refers to the operating rules for commercial operation of large aeroplanes, which require that the aeroplane is free of ice contamination before take-off and that ice accretion starts at the end of the take-off distance (see AMC 25.21(g) 4.1.1 and part II (a)(1) of Appendix C to CS-25).

Despite the above, incidents and accidents have been caused by the degradation of aircraft aerodynamic performances, reduction of safety margins and reduction of manoeuvrability/controllability due to airframe ground icing contamination or inadequate de-/anti-icing operations. EASA has received a number of safety recommendations, in this respect.

Through past incidents and accidents, three categories of risks have been identified:

a) Take-off with wings contaminated by ground icing conditions:

On 25 January 2007, a Fokker F28 Mk0100, registration F-GMPG, lost control during take-off from Pau-Pyrénées airport, France and performed an emergency landing in a field in front of the runway[2]. The investigation concluded that a contributing factor to the loss of control was the presence of ice contaminants on the wings surfaces. The deposit of the wings indeed changed the aeroplane performance and handling qualities.

As a result, the BEA issued the following safety recommendation (ref. FRAN-2009-001):

'The BEA recommends that while being watchful to keep the operational requirements relating to the ground de-icing pre-flight check, EASA sets out to improve the certification specifications to require the analysis of aircraft behaviour when, the wings surfaces are contaminated on ground and to guarantee the maintaining of acceptable safety margins, in case of slight contamination.'

Another accident, caused by non-de-icing of the aircraft, involved a Bombardier CL600-2B16 aircraft (registration N90AG) during take-off at Birmingham International Airport on 4 January 2002[3].

After investigation, the following safety recommendation (ref. UNKG-2003-060) was issued :

'It is recommended that the FAA and JAA review the current procedural approach to the pre-take-off detection and elimination of airframe ice contamination and consider requiring a system that would directly monitor aircraft aerodynamic surfaces for ice contamination and warn the crew of a potentially hazardous condition.'

On 4 March 2013, a Beechcraft Premier 1A, registered VP-CAZ, lost control during take-off from Annemasse, France[4]. The BEA investigation concluded that the accident was caused by the pilot's insufficient appreciation

1 Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L296, 25 October 2012, page 1).

2 BEA report N°ISBN: 978-2-11-097915-5, entitled « Accident survenu le 25 janvier 2007 sur l'aérodrome de Pau Pyrénées (64) au Fokker F28 Mk0100 immatriculé F-GMPG exploité par Régional, Compagnie Aérienne Européenne ».

3 Aircraft Accident Report 5/2004 from the Air Accidents Investigation Branch, Department for Transport.

of the risks associated with ground-ice, which led him to take off with contamination of the critical airframe surfaces. This contaminant deposit then caused the aerodynamic stall of the aeroplane and the loss of control shortly after lift-off.

Several safety recommendations were issued, including the following one(ref. FRAN-2014-006):

'EASA, in coordination with the FAA and the other non-European civil aviation authorities, study the technical and regulatory means to put in place in order to install systems for the detection of frozen contaminants on the critical surfaces of aircraft'.

b) Ice contamination of wings by cold-soak surface effect

Ice can form on the external surfaces of cold-soak aircraft, even when the outside temperature is above 0°C, in presence of visible moisture, high humidity, or water precipitation, provided that the airframe surface remains at 0°C or below. Two typical cold-soak effect sources exists:

— Cold fuel present in fuel cells (either because the aircraft flew in very cold air at altitude, or because very cold fuel was added to the tanks on ground); and

— Cold massive airframe structural parts (e.g. after flight in very cold air temperature at altitude).

Cold-soak ice contamination can appear on the ground, but also in flight when the aircraft descends and encounters warmer air altitudes. The phenomenon is well known for potentially appearing on wings or horizontal stabilisers surfaces, but it can also appear on other airframe surfaces.

c) De-icing/anti-icing fluids effect on the aerodynamic performance, safety margins and manoeuvrability and controllability of the aeroplane at take-off.

In order to remove ice contamination from the aeroplane surfaces on the ground, aeroplanes are treated with low freezing points fluids (de-/anti-icing fluids) before take-off. They are a necessary element to operate the aeroplanes in 'ground icing conditions', providing protection against ice contamination up to the moment of rotation for lift-off. Nevertheless, the presence of the fluids also affects the aerodynamic characteristics of the aeroplanes. De-/anti-icing fluids are developed in compliance with international standards which intend to ensure that the fluids will leave the aeroplane surfaces during the take-off roll, before lift-off. However, there is no regulation mandating the evaluation of the effects of these fluids by the aeroplane manufacturers.

On the other hand, incidents have also been reported where the fluid was the main contributing factor to the event.

For instance, a serious incident with a British Aerospace ATP aeroplane (registered SE-MAP) occurred on 11 January 2010 at Vantaa airport, Helsinki, Finland[5].

The investigation by the Swedish accident investigation body (SHK) showed that several similar incidents involving the same type of aeroplane and similar conditions had occurred before. The incidents involving elevator restrictions were caused by a phenomenon which, for unknown reasons, occurs following the use of anti-icing fluids containing thickening agents on individual aeroplanes where the stabiliser and elevator are too close together.

[4] Final BEA report published May 2014 available on BEA Website: https://www.bea.aero/fileadmin/documents/docspa/2013/vp-z130304.en/pdf/vp-z130304.en.pdf

[5] Final report RL 2011:16e, Serious incident to aircraft SE-MAP at Helsinki/Vantaa Airport in Finland, on 11 January 2010.

In addition to recommend an extension of the EASA's remit to include certification of fluids used for ground de-/anti-icing of aircraft, SHK also recommended the following (ref RL 2011:16e R2/EASA ref. SWED-2011-016):

EASA 'should investigate the possibility of tightening requirements on aircraft design organizations in terms of demonstrating that the aircraft has full manoeuvrability during all phases of the take-off procedure after the application of de- and anti-icing fluids.'

2. What we want to achieve — objective

This task will contribute to the achievement of the overall objectives of the EASA system as defined in Article 2 of Regulation (EC) No 216/2008.

The specific objective of this task is to mitigate the risk of loss of control of an aeroplane (in particular during, but not limited to, the take-off phase), and the risk of runway excursion after an aborted take-off at high speed, caused by an aerodynamic performance or controllability degradation, as a result of aerodynamic surfaces contamination by ice or de/anti-icing fluids.

3. How we want to achieve it

To achieve this objective, it shall be considered to amend the existing specifications and/or introduce new certification specifications and acceptable means of compliance into CS-23 and CS-25 requiring the applicant for a type certificate to perform an assessment of the effect of contaminated aerodynamic surfaces on aircraft performances, handling qualities and controllability. Any hazardous safety effect identified through this evaluation must be mitigated by the applicant through acceptable design and/or operational means.

In addition, it shall be considered whether similar requirements should be imposed on certain already certified large aeroplanes through an amendment to Part-26/CS-26.

For that purpose it is suggested:

— to review the different studies and reports related to ice contamination of aeroplane aerodynamic surfaces;

— to review the different studies and reports relating to the application of de-/anti-icing fluids on aeroplane aerodynamic surfaces;

— to review all the potential effects of application of fluids on the aeroplane performances;

— to take into account the relevant recommendations from the accident investigations boards (France, Sweden, United Kingdom); and

— to consider similar activities undertaken by foreign aviation authorities such as the FAA and Transport Canada.

Note 1: As cold-soak surface may also result in 'in-flight' contamination, other flight phases than take-off may have to be considered during this rulemaking task.

Note 2: Potential impact of these activities on the AFM content may have to be considered during this rulemaking task.

4. What are the deliverables

— Notice of Proposed Amendment (NPA) proposing possibly an amendment to CS-23 and CS-25, and to Part-26/CS-26, including a regulatory impact assessment (RIA);

— Comment-response document (CRD) providing responses to the comments received on the NPA;

— Possibly an Executive Director Decision amending CS-23 and CS-25;

— Possibly an Opinion amending Part-26 and a related Executive Director Decision amending CS-26.

5. Related Study

To address the safety recommendation SWED-2011-016, EASA had already launched a research project on 'De-Icing Fluid Tests (DIFT)' aiming to replicate the phenomena, understand the causes of the reported events and establish the most adverse conditions. In this research project, an aerodynamic model representing a horizontal stabiliser was exposed to an accelerated stream in a wind tunnel to simulate the actual conditions of a typical aeroplane during a take-off run and to measure the stabiliser lift and elevator hinge moments over time to assess the impact of the applied anti-icing fluids. The conclusions of this research are published in EASA Safety Information Bulletin (SIB) N° 2015-18 on Potential Adverse Effect of Anti-Icing Fluids during Take-off, issued on 8 October 2015.

This regulatory task will take benefit of the results of the research and of recommendations included in SIB N° 2015-18.

6. Profile and contribution of the rulemaking group

— Participation of manufacturers: the rulemaking group should comprise several (ideally, at least three) members representing aeroplane manufacturers from European and non-European manufacturers. The required expertise shall be in the domain of icing and ground de-icing, aeroplane performance and handling qualities, and flight control systems.

— Participation of foreign aviation authorities: in the interest of harmonisation, FAA and TCCA participation is recommended.

7. Reference documents

7.1. Affected regulations

Possibly (further to an analysis of impacts), Commission Regulation (EU) 2015/640 of 23 April 2015 on additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012 (OJ L 106, 24.4.2015, p. 18).

7.2. Affected decisions

Possibly (further to an analysis of impacts), Decision No. 2003/2/RM of the Executive Director of the Agency of 17 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for large aeroplanes ('CS-25');

Possibly (further to an analysis of impacts), Decision No. 2003/14/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications, including airworthiness codes and acceptable means of compliance for normal, utility and commuter category aero)planes ('CS-23').

Possibly (further to an analysis of impacts), ED Decision 2015/013/R of 8 May 2015 adopting Certification Specifications for additional airworthiness specifications for operations 'CS-26 — Issue 1'.

7.3. Reference documents

— BEA report N°ISBN: 978-2-11-097915-5, entitled « Accident survenu le 25 janvier 2007 sur l'aérodrome de Pau Pyrénées (64) au Fokker F28 Mk0100 immatriculé F-GMPG exploité par Régional, Compagnie Aérienne Européenne, and in particular SR FRAN-2009-001.

— Aircraft Accident Report 5/2004 from the Air Accidents Investigation Branch, Department for Transport, and in particular SR UNKG-2003-060.

— Final report RL 2011:16e, Serious incident to aircraft SE-MAP at Helsinki/Vantaa Airport in Finland, from 11 January 2010, and in particular SR SWED-2011-016.

— BEA final report on the accident on 4 March 2013 just after takeoff from Annemasse (France) to the Beechcraft Premier 1A registered VP-CAZ, published May 2014.