Safety Information Bulletin

Airworthiness – Operations

SIB No.: 2015-18

Issued: 08 October 2015

Subject: **Potential Adverse Effect of Anti-Icing Fluids during Take-off**

Ref. Publications:

- EASA SIB No.: 2010-28
- EASA SIB No.: 2012-20
- Transport Canada Civil Aviation Safety Alert (CASA) 2010-02 iss. 2
- SHK Final report RL 2011:16e (Serious Incident to aeroplane SE-MAP)
- European Authorities Coordination Group on Flight Data Monitoring (EAFDM) – "Developing standardised FDM-based indicators (Dec. 2013)".

Applicability:

Operators and pilots of the affected aeroplanes subject to ground anti-icing treatment. Typically affected aeroplanes are those with unpowered elevator controls and low or medium take-off rotation speeds.

Description:

Over the last years, EASA has been made aware of incidents occurring during the take-off with aeroplane to which thickened de/anti-icing fluids (type II and IV fluids as per SAE standard AMS1428) have been applied. The incidents have been reported for various aeroplane types, mainly aeroplanes with unpowered flight controls and low to medium rotation speeds (around 100 knots). The pilots typically reported these incidents as difficulty or inability to rotate the aeroplane at the computed rotation speed Vr.

The Swedish accident investigation body (SHK) investigated a related serious incident (see Ref. Publications) and raised the safety recommendations ref. RL 2011: 16e R1, R2 and R3 to EASA.

To address the safety recommendation RL 2011: 16e R2, EASA first 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 the research project, an aerodynamic model representing an horizontal stabiliser was exposed to an accelerated stream in a wind tunnel, modelling the actual conditions of a typical aeroplane during a take-off run, and the stabiliser lift and elevator hinge moments were measured over time to assess the impact of the applied anti-icing fluids.

This SIB is published to share the findings of this research with potentially affected pilots and operators and provide recommendations to assess the potential impact and mitigate it.

Note 1: This SIB does not address issues related to rehydrated residues of anti-icing fluids.

The wind tunnel testing performed within the scope of the DIFT research project confirmed the potential hazard of increased stick forces during rotation at take-off:

a) for aeroplane with reversible longitudinal flight controls

b) when thickened de/anti-icing fluids are applied

The following summarises the findings from the research project:

- For most cases analysed, the anti-icing fluid significantly affected the aerodynamics of the horizontal stabiliser. As a consequence, the peak values of the control column forces that were required to move the elevator (control column force applied by the pilot) significantly increased (double or more) while the lift generated by the stabiliser diminished (around 20%) at the time of rotation, when compared with a dry take-off. These two effects would add together and delay the moment of aeroplane rotation (rotation would take place a few seconds after the pilot command input to the control column), reducing the runway margins.
- These measured values were transient (while fluid was flowing-off from the stabiliser and elevator surfaces), and the measured values approached to acceptable levels seconds after elevator normal deflection.
- Fluids with very low viscosity (type I) did not have an appreciable effect. All type II and IV fluids considered had a relevant impact, also when diluted. Results show that the relationship between viscosity and the model aerodynamic performance penalty is not linear.
- The cases representing a heavy aeroplane with a forward c.g. position provided the more penalising results in terms of absolute increase of hinge moment forces (pilot forces) and lift reduction. This condition corresponds to higher required elevator deflection but slow accelerating aeroplane and therefore, more time for the fluid to flow-off and to contaminate the lower side of the elevator.
- When the anti-icing fluid was applied in a two-step process (after de-icing), results were comparable to a single anti-icing application case.
- Temperature variations did not significantly affect the results.
- The gap between the stabiliser and the elevator[1] influences the hinge moment and lift characteristics both for dry and wet cases. The tests showed the anti-icing fluids significantly affected, when compared to the corresponding dry case, the values measured for all the gaps considered. The tests results suggested that, within the studied gap range, the larger gaps promote the penalty increase as they result in larger fluid migration and contamination of the lower elevator surface.

Further details on the research and their findings were presented to relevant industry representatives on 23 March 2015. The information presented at that time is accessible here (contains links to video recordings). The detailed research report is available here.

Note 2: The research was trying to represent normal operating conditions to the most possible extent. Therefore, the findings can be considered to describe/identify the parameters influencing the aerodynamic impact of the anti-icing fluid. However, considering the assumptions and simplifications required (e.g. stabiliser geometry), the findings and the values measured cannot be extrapolated to a particular aeroplane nor to real operations.

At this time, the safety concern described in this SIB is not considered to be an unsafe condition that would warrant Airworthiness Directive (AD) action under Regulation (EU) 748/2012, Part 21.A.3B, and it does not warrant the issuance of a safety measure under Regulation (EU) 965/2012, Annex II, ARO.GEN.135(c).

Recommendation(s):

1. Operators should evaluate if they are potentially affected (in case of operating potentially affected aeroplanes under similar operating conditions). In this case, they should revise their operating manuals for compliance with type certificate holder (TCH)'s instructions, and train their crews accordingly.

[1] The gap between the stabiliser and elevator was identified in SHK's incident report as a potential contributing factor to the incidents, therefore different gap sizes were tested to assess its influence.

2. An operator that has evaluated that this risk is inherent to its operation should quantify its significance.

   One way to achieve this may be by developing Flight Data Monitoring-based indicators on its operational data, to assess if pilots forces (in case these are recorded) have exceeded acceptable values, and/or if take-off performance (time to rotation/rotation speeds/take-off distance) has diminished beyond acceptable values when the aeroplane has been treated with anti-icing fluids.

   Any associated findings and relevant incidents should be reported to the TCH, the relevant National Aviation Authorities and EASA.

3. Some of the potentially impacted TCHs are aware of the phenomena and already provide operating procedures/instructions to overcome/diminish the adverse effects and operate safely. Further action might be taken also in context of the ongoing discussions between EASA and TCHs.

   In any case, operators are reminded to always follow Aircraft Flight Manual procedures and winter operations instructions published by the TCH, and to contact them in case of doubt.

Contact(s):

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