

**Boeing 737-800,
G-JZHL**

**Kuusamo Airport,
Finland**

01 December 2021

Serious Incident

Investigation Synopsis

This investigation was delegated to the AAIB by the Safety Investigation Authority of Finland.

During takeoff from Kuusamo Airport in Finland the flight crew inadvertently left the thrust set at the 70% engine run-up setting rather than the 89% required for takeoff. The aircraft became airborne with 400 m of runway remaining and climbed away slowly. At 250 ft agl the flight crew realised they had insufficient thrust and applied the correct power. The flight continued without further incident.

The thrust was not set correctly because the TOGA button was not pressed. It was not pressed because the co-pilot was startled by the aircraft starting to move when he set 70% power against the brakes. The aircraft started to move because the co-pilot applied insufficient brake pressure. The commander was distracted by a radio call and neither he, nor the co-pilot, checked the thrust was correctly set.

The AAIB has investigated several takeoff performance incidents across the industry. This incident is further evidence that the current barriers designed to prevent these events are not fully effective, and improved reliability is likely only through the introduction of a technical barrier. A Safety Recommendation is therefore made to develop technical specifications and, ultimately, certification standards for a technical solution.

A Safety Recommendation is also made to improve the detection of takeoffs with compromised performance, to support the prompt reporting of occurrences.

Safety Recommendation 2022-018

Justification

The AAIB and other SIAs have investigated many takeoff performance incidents which have resulted in aircraft taking off with insufficient thrust. The circumstances of each incident differ but the outcome is the same. The human checks currently in place do not always stop these incidents occurring. Whilst they are effective in many cases, such checks are occasionally omitted or fail to detect errors because there is a limit to the reliability that can be achieved with any human task. Higher levels of reliability are likely to require technological intervention to detect abnormally low acceleration during takeoff in time to enable crews to safely reject the takeoff. SR 2018-014, made to EASA, addressed this issue when the UK was part of the EU. SR 2022-018 addresses the same issue but is made to the UK CAA.

Therefore, the following safety recommendation was made:

Safety Recommendation 2022-018

It is recommended that the UK Civil Aviation Authority, in conjunction with other regulatory authorities, develop a set of technical specifications and, subsequently, develop certification standards for an on-board system that will alert the crew of an aircraft to abnormally low acceleration during takeoff.

Date Safety Recommendation made: 29 September 2022

LATEST RESPONSE

Response received: 26 February 2024

The UK CAA recently presented our proposal to the EUROCAE Technical Advisory Committee on 16th January 2024 for the continuation of their previous Working group 94 discussing Take off performance Monitoring. There was positive feedback post the presentation which EASA was also present and endorsed our proposal.

Post this meeting, the EUROCAE council reviewed our proposal and agreed to the creation of WG-129 to look at Minimum operational Performance specifications (MOPS) or Minimum Aviation System Performance Specification (MASPS) for a "Take Off Performance Monitoring (TOPM) System".

The UK CAA has been allocated a place at this working group and we will arrange a meeting with the programme manager to look at a road map prior to a kick off meeting.

As this EUROCAE working Group has been agreed and is in its infancy, the Civil Aviation Authority would like to propose that our next update to AAIB recommendation 2022-018 shall be provided by the end of February 2025.

Safety Recommendation Status Open

AAIB Assessment Partially Adequate

Action Status Planned Action Ongoing Update Due 28 February 2025

Feedback rationale

The AAIB acknowledges the CAA's responses and requests an update by the end of February 2025. (EU Regulation 996/2010 article 18 refers).

RESPONSE HISTORY

Response received: 30 June 2023

The UK CAA, through our Design and Certification department, has been investigating any previous work into the development to monitor dynamic take-off performance with the ability to warn the pilot.

The UK CAA has discussed the development in this area with the FAA and EASA; whilst we do not believe either of these authorities are engaged in any certification activity of dynamic take-off monitoring, they both recognise the risk and have both positively engaged with us.

In addition, the UK CAA presented this topic at the FAA InfoShare, where contact was made with US airlines, regulators, and OEMs. Following this, we have had a workshop with Southwest Airlines that have shared their algorithms, and a follow-up with Boeing Safety team to discuss Boeing activities to find mitigations for this type of event. These are ongoing relationships; the UK CAA are facilitating a link for UK B737 operators directly with Southwest safety department.

The UK CAA has recently written to EUROCAE, requesting that a proposal be tabled at the next council meeting or Technical Advisory Committee to consider re-opening this working group to prepare MOPS / MASPS, which could ultimately form the basis of regulatory action that could reduce the number of take-off performance events.

The Civil Aviation Authority would like to propose that our next update to AAIB recommendation 2022-018 shall be provided by the end of February 2024.

AAIB Assessment – Partially Adequate Open

Response received: 02 December 2022

The UK CAA accepts this Safety recommendation.

In order to ensure any UK position is coordinated with other key aviation regulatory bodies, we have started engagement to determine what, if any, parallel workstreams are already in process. We have also started engagement with Organisations developing standards for Aviation Equipment to understand if they have already been approached to work towards an agreed Minimum Operational Performance Standard (MOPS) for any design solution. Any future mandate that is associated with agreed technical specifications will require further consultation – ideally with a coordinated regulatory action.

A workshop with key UK airlines is planned for Q1 2023 to start the initial scope of a technical solution. This will be followed by OEM meetings and further regulator outreach to try and maintain common collective position. The consequences and viability of a UK only approach will have to be considered in due course if a more global consensus is not possible.

The Civil Aviation Authority would like to propose that our next update to AAIB recommendation 2022-018 shall be provided by the end of June 2023.

AAIB Assessment – Adequate Open

Safety Recommendation 2022-019

Justification

Flight data monitoring (FDM) can be used to monitor the frequency of occurrences of takeoff performance events and to ensure they are reported appropriately. EASA has published guidance material on the subject and has recommended that operators implement in their FDM programmes specific algorithms to detect precursors relevant to the monitoring of takeoff performance. SR 2022-019 aims to encourage operators to use FDM in this way.

Therefore, the following safety recommendation was made:

Safety Recommendation 2022-019

It is recommended that the UK Civil Aviation Authority encourage all UK Air Operator Certificate holders to implement into their flight data monitoring programme algorithms to detect the precursors relevant to the monitoring of takeoff performance detailed in the European Operators Flight Data Monitoring Document, Guidance for the implementation of flight data monitoring precursors.

Date Safety Recommendation made: 29 September 2022

LATEST RESPONSE

Response received: 26 February 2024

Following the introductory workshop in December 2022, the CAA hosted two further workshops relating to Take-Off Performance. The second of these, held on the 21st November 2023, specifically addressed the use of Flight Data Monitoring to assess take-Off Performance issues, including how to identify pre-cursor events.

The purpose of the workshop was to encourage the use of FDM for two purposes:

- (1) To quantify, using historical data, the number of previously unknown take-off performance events that have occurred.
- (2) To encourage operators to analyse new data for Take-Off Performance events.

The outcome from the workshop was that operators would analyse their historical data for low acceleration events. The CAA will investigate a method by which operators could pool take-off performance data, in order to quantify cross-industry low acceleration events. This data would be presented as a pool, categorised only by airport and runway. The concept is that each operator would only be able to see their data relative to an unidentifiable industry pool but would allow the CAA and operators to see cross-industry airport and runway hotspots (if they occur).

Although the document referenced in the AAIB recommendation (European Operators Flight Data Monitoring Document, Guidance for the implementation of flight data monitoring precursors) is a thorough and useful reference, there remains challenges to effectively measure some of the events or the associated risk exposure contained within the document recommendations. This document has been distributed to the larger airlines to encourage them to compare their current FDM events against those contained in the document. The smaller aircraft operators (corporate airlines) have also been engaged through the relevant liaison group.

The CAA will be restarting the cross-industry FDM forum in Q2/2024 which is expected to continue the work already conducted in the specific area of take off performance monitoring as part of a wider agenda.

The Civil Aviation Authority would like to propose that our next update to AAIB recommendation 2022-019 shall be provided by the end of February 2025. This will allow time for a data collection to be progressed both externally from Industry and internally within the CAA to identify a data collection system.

Safety Recommendation Status **Open**

AAIB Assessment **Adequate**

Action Status **Planned Action Ongoing Update Due 28 February 2025**

Feedback rationale

The AAIB acknowledges the CAA's responses and requests an update by the end of February 2025. (EU Regulation 996/2010 article 18 refers).

RESPONSE HISTORY

Response received: 30 June 2023

The CAA wrote to key airlines in December 2022 describing the safety concern and the activities we are considering. The letter contained information on current reliance on the human barrier to avoid the safety risk manifestation, and potential to use FDM data to detect the precursors or undetected events. The letter was well-received, and all agreed to support any associated initiatives.

The CAA hosted a preliminary workshop for the main airlines in January 2023, which introduced the CAA Bow Tie and barriers/controls. The workshop agreed an FDM workstream would be launched to determine what common markers could be used to 'measure' the size of the safety concern, and potentially identify unknown 'near-misses'.

Other UK airlines are also active in investigating FDM potential to measure reduced performance margins. The various FDM threads will be brought together via the FDM group, including possible amendments to CAP739.

The Civil Aviation Authority would like to propose that our next update to AAIB recommendation 2022-019 shall be provided by the end of February 2024.

AAIB Assessment – Partially Adequate Open

Response received: 02 December 2022

The UK CAA accepts this Safety recommendation.

The UK CAA recognises that the identification of the correct threat line, which could lead to a runway excursion event, is an important part of any safety risk mitigation strategies for the Take-off Performance errors.

The UK CAA will seek to maximise the safety benefit of the Flight Data Monitoring (FDM) programmes by

- Identifying FDM events that can be easily linked to take-off performance errors as 'precursors' to the undesired outcome (runway excursion).

- Agree on common trigger values that could be used to produce a wider data set to identify sector risks to share with all operators, subject to confidential protocols being agreed and accepted.

We plan to do this by working with large Air Operator Certificate (AOC) organisations through dedicated workshops and publish FDM 'best practice considerations' by the end of 2023.

The Civil Aviation Authority would like to propose that our next update to AAIB recommendation 2022-019 shall be provided by the end of June 2023.

AAIB Assessment – Adequate Open