Safety Information Bulletin

Operations

SIB No.: 2016-02

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Subject: **Use of Erroneous Parameters at Take-off**

Ref. Publications:

- U.S. National Air & Space Administration (NASA) Study NASA/TM-2012-216007 "Performance Data Errors in Air Carrier Operations: Causes and Countermeasures".
- Australian Transport Safety Bureau (ATSB) Research and Analysis Report AR-2009-052 "Take-off Performance Calculation and Entry Errors - A Global Perspective".
- Laboratory of Applied Anthropology, on behalf of BEA (Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile) and DGAC France: DOC AA 556/2008 "Use of erroneous parameters at take-off".
- EASA AMC 20-25 "Airworthiness and Operational consideration for Electronic Flight Bags (EFB)".
- European Commercial Aviation Safety Team (ECAST) European Operators Flight Data Monitoring:
  - Working Group A: "Review of Accident Precursors for Runway Excursions" and
  - Working Group B: "Study for Runway Excursion Precursors".
- European Authorities coordination group on Flight Data Monitoring (EAFDM) Document "Developing standardised FDM-based indicators".

Applicability:

Competent Authorities, Operators, Approved Training Organisations (ATO).

Description:

The investigation reports and studies related to a number of accidents and serious incidents worldwide have highlighted a safety issue related to the use of erroneous mass data or take-off performance data. The analysis conducted showed also that various aircraft types have been involved making this a general safety concern.

This SIB focuses mainly on errors induced by flight crew when entering data in the Electronic Flight Bag (EFB) or Flight Management system (FMS) during the flight preparation phase. The main contributing human factors to such errors are time pressure and task interruptions with the consequences being take-off initiation without adequate thrust, or attempted rotation at an airspeed which is too low for the actual aircraft mass, or with insufficient runway length remaining. In some cases there were no further consequences, but in most of the cases investigated the safety issue resulted in a tail strike, a collision with obstacles, a runway overrun following an aborted take-off and, in the most severe situations, the loss of the aircraft.

The investigators found that, in most cases, the flight crew had entered inadequate values related to take-off mass, safety speed values or target take-off thrust into the Flight Management System (FMS) in relation to the runway in use.

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Calculating take-off performance data and entering this data into the FMS involve a number of steps that create potential for errors. The following list provides examples of common errors identified in relevant investigation reports and available safety studies (see references):

- the Zero Fuel Weight (ZFW) is inadvertently used (in EFBs, flight dispatch computers, FMS etc.) instead of the Actual Take Off Weight (ATOW) in calculating performance data; an incorrect value is selected from the load sheet or take-off data card;
- the aircraft weight is incorrectly transcribed or transposed into an aircraft system or when referencing performance manuals;
- the Centre of Gravity (CG) value is incorrectly transcribed or calculated;
- take-off reference (V) speeds are incorrectly transcribed or transposed when manually entered into FMS or aircraft systems;
- aircraft data from a previous flight is used to calculate the take-off reference (V) speeds;
- take-off performance parameters are not updated as a result of a change in operational conditions, for example, a change in the active runway or condition (wet, contaminated, etc.), departure from a runway intersection, change in the wind conditions, ambient temperature, temporary runway length restrictions, etc.;
- wrong performance charts are used;
- the wrong table or column/row is inadvertently selected in the performance charts;
- an incorrect value is used when referencing the performance charts;
- an error is made when converting values into the required unit of measurement;
- wrong slats/flaps setting is used compared to the calculated take-off performance;

Even if it can be assumed that the vast majority of errors were detected and corrected by the involved personnel, it is likely that several other events have occurred and have not been reported, either because they were uneventful or because the issue has not been identified by the flight crew during the take-off. It is therefore important that this safety issue is monitored more closely and that operators collect more data in order to gain better awareness and understanding of the frequency and potential severity of those events.

The purpose of this SIB, in conjunction with procedures and guidance provided by the aircraft manufacturers, is to:

- raise awareness of the specific hazard to flight crews, operators and competent authorities;
- provide recommendations to operators on the completion of a specific safety risk analysis and assessment related to this issue, in order to assess the effectiveness of mitigations in place and determine the need for additional or alternative action(s);
- provide recommendation on training items to be emphasised during flight crew initial and recurrent training to increase awareness on the issue; and
- provide recommendations on the use of the operator's Flight Data Monitoring (FDM) programme to identify precursor events.

EASA conducted a "survey on erroneous take-off parameters" for which the results suggest that defining and implementing even a few FDM events specific to this issue could help to improve the detection of the frequency and severity of related occurrences and act on the occurrences.

In order to capture more events, Flight Data Monitoring (FDM) can be used as it allows to monitor some of the situations described above. The additional data collected could help operators in

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assessing the frequency and severity of events related to this issue as part of their established safety risk management processes, and consequently, to evaluate the effectiveness of the existing mitigations put in place in their organisation.

The European Operators Flight Data Monitoring (EOFDM) and the European Authorities Coordination Group on Flight Data Monitoring (EAFDM) have made several proposals for monitoring take-off performance in day-to-day operations. In particular, the EOFDM document "Review of Accident Precursors for Runway Excursions" analyses the hazards and the possible precursors of a runway excursion. The EOFDM document "Study for Runway Excursion Precursors" addresses possible algorithms for practical implementation. This document identifies several FDM events which could be relevant to monitor take-off performance issues. Guidance on FDM events related to the risk of runway excursion is also contained in the EAFDM document "Developing Standardised FDM-Based Indicators".

As an example, operators may consider specific FDM events in their FDM Programme in order to determine their exposure to the risk related to the use of erroneous take-off parameters: e.g. slats/flaps change during take-off; short runway remaining at lift-off; time between nose gear uncompress and lift-off, etc. This may require the recording of specific flight parameters that are not always already available, as well as extensive programming of the FDM software.

Based on the publications referenced in this SIB, the possible mitigation elements that can be implemented are the following:

1. Adequate flight crew procedures and training related to take-off parameter calculation, verification methods, common errors, contributing factors and error trapping;
   Note: two independent calculations are required by AMC 20-25 Appendix F paragraph F.1.3 when using an EFB. This means that each crew member should perform the whole calculation instead of a single calculation cross-checked by the other crew member, the results being cross-checked before further use. Independent calculations are a way to reduce the chances of accepting erroneous data;

2. Flight crew training related to the identification of inadequate take-off performance and the initiation of appropriate actions; and

3. Aircraft systems software performing automated gross error checks of values entered and computed. Some examples:
   - Electronic cross check or uploading between FMS and EFB Performance / Weight & Balance (W&B) application.
   - Electronic cross check between EFBs Performance / W&B application.
   - Electronic cross check between QFU/intersection in FMS and real take-off position.
   - Tail strike protection through flight controls.
   - Additional barriers on data insertion in the FMS and/or EFB Performance / W&B application (automatic data insertion, consistency checks, cross checks, etc.).
   - On board W&B computation.
   - On board system to detect that the remaining runway is insufficient for an aborted take-off.
   - Electronic cross check between flaps selected for calculations and real flaps position at take-off.

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- Integrated software taking into account contextual information such as crew planning (origin and destination for performance calculations), total mass of the aircraft, fuel mass used for flight planning and for loadsheet, etc.

At this time, the safety concern described in this SIB does not warrant taking safety measures under Regulation (EU) 965/2012, Annex II, ARO.GEN.135(c).

Recommendation(s):

Management system: EASA recommends that operators and ATOs consider the risk related to the use of erroneous take-off parameters. A dedicated safety risk analysis and assessment should be conducted to evaluate if the procedures in place are adequate or if additional/alternative mitigations should be defined. In particular, the following scenarios should be analysed with respect to the probability of:

- using wrong reference data for computerised performance calculation;
- making errors in mass and balance or take-off performance calculation;
- incorrect transcription of data to avionic systems (e.g. incorrect transcription to the FMS);
- incorrect loading of the aircraft;
- using erroneous weather/runway data; and
- inefficient cross-checking between flight crew.

Note: the effects of workload, time pressure, and fatigue should be considered when studying the scenarios above.

Flight crew training: EASA recommends that operators and ATOs emphasise, during initial and recurrent flight crew training, the following:

- Prevention: consider the issue in the context of Crew Resource Management training, as well as raising flight crew awareness on the issue of automation overreliance and the need to conduct appropriate consistency checks (e.g. mental gross error check, the pilots should know a few rules of thumb to detect large inconsistencies, and be encouraged to apply them during the pre-flight check, cross check of the EFB outputs).
- Situational awareness during take-off roll to ensure detection of erroneous take-off parameters. (e.g. low acceleration, sluggish and/or nose heavy rotation, rough idea of the runway position where V1 or Vr should be passed).
  Note: In order to avoid negative training, the user should verify the adequacy of the used Flight Simulation Training Device(s) and its qualification level.
- Raise/ascertain flight crew awareness on possible recovery measures (e.g. apply TOGA).

FDM: EASA recommends operators to define and implement specific FDM events relevant to the monitoring of take-off performance issues in their FDM programme. Some suggestions can be found in the list of documents referenced in this SIB.

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