European Union Aviation Safety Agency

Safety Information Bulletin

Operations

SIB No.: 2016-02R1

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

Revision:

This SIB revises EASA SIB 2016-02 dated 16 February 2016.

Ref. Publications:

- United States National Air & Space Administration (NASA) Study NASA/TM-2012-216007 "Performance Data Errors in Air Carrier Operations: Causes and Countermeasures" dated June 2012.
- Australian Transport Safety Bureau Research and Analysis Report AR-2009-052 "Take-off Performance Calculation and Entry Errors - A Global Perspective" dated 24 January 2011.
- Laboratory of Applied Anthropology, on behalf of Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile and Directorate General for Civil Aviation France DOC AA 556/2008 "Use of erroneous parameters at take-off" dated May 2008.
- Commission Regulation (EU) 965/2012 dated 05 October 2012, annex V, subpart SPA.EFB.
- European Operators Flight Data Monitoring forum (EOFDM):
  - Working Group A: "Review of Accident Precursors" and
  - Working Group B: "Guidance for the implementation of FDM precursors".

Applicability:

Competent authorities, operators, flight crews.

Description:

The investigation reports and studies related to several accidents and serious incidents worldwide have highlighted the use of erroneous mass or take-off performance data as a safety issue of general concern and not specific to any aircraft type.

This SIB focuses mainly on errors of 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/take-off configuration, or with insufficient runway length remaining. In most of some the cases investigated, flight crew had entered inadequate values related to take-off mass, safety speed values or target take-off thrust into the FMS in relation to the runway in use.

The consequences of these erroneous data entries included tail strikes, collisions with obstacles, runway overruns following an aborted take-off and, in the most severe situations, the loss of the aircraft.

Calculating take-off performance data and entering this data into the FMS involves 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 Ref. Publications):

- the Zero Fuel Mass is inadvertently used (in EFBs, flight dispatch computers, FMS, etc.) instead of the Actual Take Off Mass in calculating performance data; an incorrect value is selected from the load sheet or take-off data card;
- the aircraft mass is incorrectly calculated, 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 calculated, 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.

Whilst the vast majority of errors are detected and corrected by the involved personnel at the time, it is likely that other events have occurred but were not reported, either because they were uneventful or because the issue was not identified by the flight crew during the take-off or through the Flight Data Monitoring (FDM) programme. 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 these events, as well as to monitor associated trends and to assess the effectiveness of any remedial action.

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

- raise flight crews, operators and competent authorities' awareness of the specific hazard;
- 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 FDM programme to identify precursor events.

Analysis of EASA's 2015 "survey on erroneous take-off parameters" suggests that implementing even a few specific FDM event algorithms or measurement algorithms could help to improve the detection of related events and assess their frequency and severity. The notions of FDM events (also designated as 'exceedance detection') and FDM measurement (also designated as 'all-flights measurement') are explained in Part-ORO, AMC1 ORO.AOC.130 and GM1 ORO.AOC.130.

FDM can be used to systematically detect indications of insufficient take-off performance. Once a take-off showing insufficient performance is detected by the FDM software, the operator can request a report by the flight crew (under the agreed procedure for the prevention of disclosure of crew identity) and analyse this event to determine whether it was caused by erroneous take-off parameter entries or by other factors. FDM can also help operators in 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 risk mitigations put in place in their organisation.

EOFDM has proposed several methods for monitoring take-off performance with FDM. In particular, the "FDM precursors" listed below are considered relevant. The survey conducted by EASA in 2021 suggests that those precursors could be implemented by the majority of operators.

- *RE01 — Incorrect Performance Calculation*
  (Indirect indications e.g. change of thrust setting during take-off roll or excessive difference between Flex. Temperature and Outside Air temperature at take-off)
- *RE05 — Slow Acceleration*
  (during the take-off roll)
- *RE07 — Late Rotation*
  (e.g. start of rotation after the rotation speed - VR)
- *RE08 — Slow Rotation*
- *(e.g. excessive duration of the rotation to take off or too low pitch rate during the rotation to take off)*
- *LOC08 — CG out of limits*
  (e.g. CG position not consistent with longitudinal trim setting)

Note 1: The programming of some of these FDM precursors may require recording or computing flight parameters that are not readily available, as well as designing new FDM event or measurement algorithms. However, several of the FDM precursors listed here above need to be implemented to achieve effective monitoring of the take-off performance.

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 2: Two independent calculations should be performed, as stated in AMC5 -SPA.EFB.100(b)(3), when using a performance and/or a mass and balance applications on 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. This training should, if possible, include de-identified information and examples stemming from the FDM programme and flight crew reports.

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 / Mass & Balance (M&B) application.
   - Electronic cross check between EFBs Performance / M&B application.
   - Electronic cross check between QFU (Q-code for Magnetic Heading of a Runway)/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 / M&B application (automatic data insertion, consistency checks, cross checks, etc.).
   - On board M&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.
   - 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 load sheet, etc.

This SIB is revised to amend the “Description” and “Recommendation(s)” sections, in order to reflect the latest developments in the FDM programme.

At this time, the safety concern described in this SIB is not considered to be an unsafe condition that would warrant Safety Directive (SD) action under Commission Regulation (EU) 965/2012, Annex II, ARO.GEN.135(c).

Recommendation(s):

Management system: EASA recommends that operators 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 entry of data into avionic systems (e.g. incorrect entry into the FMS);
- incorrect loading of the aircraft;
- using erroneous weather/runway data; and
- inefficient cross-checking between flight crew.

Note 3: The effects of workload, distraction, time pressure and fatigue should be considered, when studying the scenarios above.

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

- Prevention: consider the issue in the context of Crew Resource Management training, in particular to raise flight crew awareness on the following non-exhaustive topics:
    - 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);
    - the management of last-minute changes (e.g. late change of the runway, use of an intersection, change of flight configuration, weather change, etc.) and the need to re-check the parameters entered;
    - the impact of distraction during take-off parameters entry into the FMS and the importance to apply adequate mitigations (e.g. division of tasks into small packages to be completed before the start of any other package, recognise distraction and double check the impacted tasks, finish calculation, data entry first, cross-check etc.).

- Situational awareness during the 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 4: 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. abort take-off, apply take-off/go-around switch).

Note 5: Information on detection and recovery strategies may be included in the pre-flight briefing between flight crew.

FDM: EASA recommends operators to implement specific FDM event algorithms (or FDM measurement algorithms) that are relevant to the monitoring of take-off performance in their FDM programme and to analyse events and adverse trends detected by these algorithms. Some suggestions are provided in this SIB.

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