

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777*.

Erroneous takeoff performance calculation, Boeing 777

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1. About the report

A Boeing 777 was scheduled for a passenger flight from Amsterdam Airport Schiphol in the Netherlands to Toronto Pearson International Airport in Canada. During takeoff a tail strike occurred. The tailstrike was caused by an over rotation of the aeroplane during the takeoff, which was the result of a lower than required airspeed at which the rotation was started. The reason for this was that the actual takeoff weight was higher than the takeoff weight that had been used for the takeoff performance calculation. Due to a human error predominantly caused by time pressure, incorrect load sheet data was supplied to the pilots. The interaction between human performance, the cross check of data by the pilots, the airline's loading procedures, limited systems integration and operational pressure to meet the planned takeoff time contributed to the takeoff performance calculation with the incorrect data as input.

Takeoff performance occurrences, such as with the Boeing 777, occur regularly and are a special group within the takeoff occurrences. They are not limited to specific aeroplane types or flight operations. They stand out because of the absence of a proper warning system and because the outcome of the majority of these occurrences is without damage or loss of life. The outcome of a performance occurrence can be catastrophic, but luckily, until now most of them resulted in the aeroplane just getting airborne before the end of the runway.

In March 2018, the Dutch Safety Board published the report *Insufficient thrust setting for takeoff*.¹ This report analyses two serious incidents involving an insufficient thrust setting for takeoff. The Board recommended in this report to the European Union Aviation Safety Agency (EASA) among others to start the development of specifications and the establishment of requirements for Takeoff Performance Monitoring Systems (TOPMS) without further delay. In the first quarter of 2020, this recommendation was under review by EASA. Such a system has to provide a timely alert to flight crew when the achieved takeoff performance is inadequate for the given aeroplane configuration and aerodrome conditions, including the runway length available in case of intersection takeoffs.

Investigation reports of state accident investigation agencies on takeoff performance occurrences show that in the past decades the airline industry has made efforts to improve the operational procedures to prevent incorrect takeoff thrust settings. However, these efforts have not resulted in a significant reduction of the risk, as takeoff performance occurrences are still encountered on a regular basis. For this reason, the Dutch Safety Board is once again making

¹ Dutch Safety Board, *Insufficient thrust setting for takeoff* (2018). Via: <https://www.onderzoeksraad.nl/en/page/3695/insufficient-thrust-setting-for-take-off-18-september-2014>

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777.*

recommendations to introduce new systems. The parties addressed have responded to the recommendations made.

This document contains a general conclusion, followed by a summary of the responses received to each recommendation and a conclusion on the way that recommendation was followed up on.

2. General conclusion about the follow-up

When assessing the follow-up to recommendations from aviation reports, the Board is bound by the assessment criteria from the European classification system, in accordance with EU regulation no. 996/2010. The European classifications and associated criteria are included in an appendix to this document.

Based on the responses received from the parties, the Board concludes as follows. In its report the Board has emphasised the importance of developing new systems which are fully integrated in the cockpit. Previous efforts by the airline industry to improve the operational procedures to prevent incorrect takeoff thrust settings, have not resulted in a significant reduction of the risk. Takeoff performance occurrences are still encountered on a regular basis. Despite this, the parties have not followed up the recommendations adequately. Only The Boeing Company has taken adequate action by actively developing a Takeoff Performance Alert (TPA) feature. Furthermore, ICAO has indicated that its Flight Operations Panel will refocus its efforts regarding Takeoff Monitoring Systems.

3. Follow-up per recommendation

Recommendation 1

To the European Union Aviation Safety Agency (EASA) and the Federal Aviation Administration (FAA)

To take the initiative in the development of specification and, subsequently, develop requirements for an independent onboard system that detects gross input errors in the process of takeoff performance calculations and/or alerts the flight crew during takeoff of abnormal low accelerations for the actual aeroplane configuration as well as insufficient runway length available in case of intersection takeoffs. Take this initiative in close consult with the aviation industry, including manufacturers of commercial jetliners amongst which in any case The Boeing Company.

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777.*

EASA response, dated 26 November 2020

In its response, EASA states the following. The effectiveness of the Safety Information Bulletin (SIB) regarding the use of erroneous parameters at takeoff² was evaluated in the frame of the Best Intervention Strategy (BIS). Information on the planning of the BIS, according to new priorities defined by EASA and the Advisory Bodies, is included in the European Plan for Aviation 2020-2024 – Appendix D. EASA developed the following short, medium and more long term initiatives in order to mitigate the residual risks associated to this safety issue:

- Short term: EASA has prepared dedicated Safety Promotion material to reinforce the messages for the SIB.
- Medium term: EASA will review the SIB 2016-02 in the light of the evaluation carried out, with special emphasis on a re-enforced use of the Flight Data Monitoring (FDM), driving the attention of the operators towards the gathering and analysis of a dedicated list of precursors.
- Long term: EASA intends to re-evaluate the feasibility of development of requirements for onboard system aimed to detect gross input errors, given the maturity evolution of some technical solutions. To do that an update version of the BIS is planned to undergo a new consultation of the Advisory Bodies in the first quarter of 2021.³

Conclusion on the follow-up

The ‘short term’ and ‘medium term’ plans of EASA do not address the intent of the recommendation made. Furthermore, the ‘long term’ plan lacks urgency. As stressed by the Board in its report, it is urgent to introduce new onboard systems that provide a timely alert to the flight crew when the achieved takeoff performance is inadequate for the given aeroplane configuration, actual weight and balance and aerodrome conditions. In accordance to the European classification, the follow-up to the recommendation is classified as **not adequate**.

FAA response, dated 8 November 2021

In its response the FAA states that it has ‘at times, observed shortcomings in training and the ability of the airline operational control and weight and balance control communicating correct information to the ground staff and flight crew.’ In order to address this issue, the FAA has updated the Advisory Circular⁴ (AC) 120-27F for operators to develop and receive approval for a weight and balance control program for specific aircraft operations. Furthermore, the FAA is developing a draft AC for flight path management. The draft AC recommends that operators provide flight crews procedures to verify/validate both the accuracy and applicability of information automation system inputs and outputs by conducting reasonable checks. These

² SIB No. 2016-02.

³ Enquiries to the FAA revealed that the submission of the BIS to consultative bodies has been delayed until Q2/2022.

⁴ Advisory circular (AC) refers to a type of publication offered by the Federal Aviation Administration to provide guidance for compliance with airworthiness regulations, pilot certification, operational standards and training standards.

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777.*

checks allow flight crews to detect and address potentially conflicting, ambiguous, inapplicable, or erroneous system inputs/outputs, and recommends incorporating these checks into existing procedures and training and provides examples.

The FAA will explore whether incorporation of a takeoff performance monitoring system could be suitable for a voluntary safety enhancement.⁵

Conclusion on the follow-up

As concluded in the report, previous efforts to improve the operational procedures to prevent incorrect takeoff thrust settings have not resulted in a significant reduction of the risk. Nevertheless, the FAA is again focusing primarily on the improvement/modification of procedures. Therefore, the follow-up to the recommendation is, in accordance with the European classification, classified as **not adequate**.

Recommendation 2

To the International Air Transport Association (IATA)

To develop a standard policy for airlines with regard to procedures for reduced thrust takeoffs, including a risk analysis addressing cost reductions versus introduced safety risks.

Response of IATA, dated 14 January 2021

In its response, IATA claims to be committed to support the industry's safety needs, including the recommendations made by the Dutch Safety Board. IATA will consider if new specifications, in accordance with IATA protocols and membership governance, are required. However, it believes that conducting a risk analysis as recommended by the Board would be inappropriate, as cost reductions are not a relevant factor in the decision to use the reduced thrust procedure in their opinion. IATA concludes that it will continue to monitor technical solutions to support reduced likelihood of incorrect takeoff data being applied and, in liaison with its industry partners, will work to bring these safety enhancements into daily operation.

Conclusion on the follow-up

In accordance with the European classification, the follow-up to the recommendation is classified as **not adequate**.

⁵ An update is expected around 31 October 2022.

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777.*

Recommendation 3

To The Boeing Company (Boeing)

For the existing and future commercial aeroplanes, to research on and develop an independent onboard system that detects gross input errors in the process of takeoff performance calculations and/or alerts the flight crew during takeoff of abnormal low accelerations for the actual aeroplane configuration as well as insufficient runway length available in case of intersection takeoff.

Response of The Boeing Company, dated 13 January 2021 and 15 December 2021

Boeing informed the Board that it is actively developing a Takeoff Performance Alert (TPA) feature that is comprised of an algorithm and flight crew alert that is being evaluated for certain existing and future Boeing models.

In an updated response Boeing informs the Board that development of the TPA is ongoing and engineering simulator evaluations are underway. Further testing and evaluation of the TPA function will continue into 2022. Boeing will provide an update to the Board on the development progress by 31 December 2022.

Conclusion on the follow-up

In accordance with the European classification, the follow-up to the recommendation is classified as **adequate**. The Dutch Safety Board continues to follow these developments with interest.

Recommendation 4

To the International Civil Aviation Organization (ICAO)

To note the conclusions of the report and introduce provisions addressing an independent onboard system that detects gross input errors in the process of takeoff performance calculations and/or alerts the flight crew during takeoff of abnormal low accelerations for the actual aeroplane configuration as well as insufficient runway length available in case of intersection takeoffs.

Response of ICAO, dated 9 February 2021

In response to the recommendation made, ICAO informed the Board that its Flight Operations Panel (FLTOPSP) reviewed a working paper regarding Take-off Monitoring Systems (TAMS) at the Working Group 6 meeting in 2019. At that time, the panel determined that there was insufficient evidence to support including provisions in Annex 6 – Operations of Aircraft based

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777.*

on a single event, and that the proposal appeared to be based on a possible fix without fully exploring what other options could be considered. In the light of the safety recommendation of the Board, the panel will refocus its efforts on this issue at the upcoming Working Group/8 meeting.

Conclusion on the follow-up

In accordance with the European classification, the follow-up to the recommendation is classified as **partially adequate**.

Subject Follow-up recommendations *Erroneous takeoff performance calculation, Boeing 777.*

Appendix 1. Assessment criteria for aviation

In assessing responses to recommendations made to the aviation sector, the Safety Board uses the guideline issued by ENCASIA on the EU Regulation on the Investigation and Prevention of Accidents and Incidents in Civil Aviation (Regulation (EU) No 996/2010). ENCASIA is the European Network of Civil Aviation Safety Investigation Authorities. The classifications and associated assessment criteria are as follows:

Category	Guidance
Adequate	<p>The response clearly shows that the safety issue identified by the recommendation has been addressed.</p> <p>The response shows that there is a high probability the action will be taken in the future to address the safety issue or intent.</p> <p>The response may not meet the intent of the recommendation as written but does address the underlying safety issue or has been superseded by other evidence/action.</p>
Partially adequate	<p>The response goes some way to addressing the intent of the recommendation or safety issue in that some action is taking place, but there is:</p> <ul style="list-style-type: none"> • a likelihood the action may not take place, or • little or no likelihood of any further action by the addressee.
Not adequate	<p>The recommendation response did not address the intent or safety issue, or the recommendation was rejected by the addressee and is not likely to be acted upon by them.</p>
Awaiting response	<p>Awaiting the first response from the addressee.</p>
Superseded	<p>The safety recommendation has been superseded.</p>

The recommendations, associated reactions and classifications are included in the European Safety Recommendations Information System (SRIS) database, publicly available via <https://sris.aviationreporting.eu/safety-recommendations>.