

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-8Q8, YR-BMF	
No & Type of Engines:	2 CFM56 7B24/3 turbofan engines	
Year of Manufacture:	1999 (Serial no: 28220)	
Date & Time (UTC):	28 July 2018 at 1010 hrs	
Location:	Birmingham Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 190
Injuries:	Crew - None	Passengers - None
Nature of Damage:	APU drain mast and tail skid components damaged	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	17,481 hours (of which 7,272 were on type) Last 90 days - 109 hours Last 28 days - 68 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

Prior to departure the aircraft's takeoff data was calculated on an electronic flight bag (EFB) using its zero fuel weight (ZFW) instead of its takeoff weight (TOW). The pilots did not crosscheck or independently calculate the data. During the takeoff the aircraft suffered a tailstrike.

Despite ATC asking the pilots if they had a tailstrike, the error subsequently being noticed in the EFB and a member of the cabin crew hearing a strange noise during the take off, the tailstrike checklist was not actioned. The aircraft continued to its destination and, after landing, damage was discovered on the underside of the aircraft.

The operator has published a safety notice reminding pilots of its procedures when calculating takeoff performance and to refer to the checklist after an unusual occurrence.

History of the flight

The aircraft was on a scheduled flight from Birmingham Airport to Bucharest International Airport, Romania, having arrived from Bucharest. These were the co-pilot's first sectors since passing his line check the day before. The commander was the PF.

During the turnaround the dispatcher informed the pilots that they had an ATC-calculated takeoff time (CTOT)¹ 54 mins after the scheduled departure time. However, they planned

Footnote

¹ If a departing aircraft is issued a CTOT, it is permitted to takeoff up to 5 minutes before and no later than 10 minutes after the time. If this can not be complied with a new CTOT will need to be issued.

to be ready to depart on time, so the co-pilot prepared the FMC and the EFB and the passengers boarded. Due to an issue with the loading of the baggage the load sheet was delayed, so the commander gave the departure brief before the takeoff performance had been calculated.

The load sheet arrived at about the CTOT and “in order to save time” the commander read out the required figures from it to the co-pilot, who entered them into the EFB. The performance data was then entered into the FMC without it, or the load sheet, being crosschecked. The aircraft then received clearance to start and taxi to Runway 15. At the time the wind was from approximately 210° at 14 kt, gusting 31 kt.

A member of ground operations at Birmingham Airport, who witnessed the takeoff, informed ATC that he believed the aircraft may have had a tailstrike, as he saw the tail of the aircraft come very close to the runway. ATC thus asked the pilots if they had had one. Neither of the pilots had noticed anything untoward and after checking the aircraft’s systems, including the pressurisation system, they replied they had not. The crew then elected to continue to their destination.

During the cruise, the commander checked the EFB and realised that he had told the co-pilot the ZFW, instead of the TOW, resulting in erroneous takeoff performance data being calculated and used. The commander then asked the cabin crew if they had noticed anything during the takeoff. The cabin crew member stationed at the rear of the aircraft said she had heard a strange noise during the takeoff but could not identify what it was. The aircraft subsequently landed in Bucharest without further event.

After landing the commander asked the aircraft engineers to examine the aircraft for evidence of a tailstrike. They discovered damage to the aircraft’s tail skid and APU drain mast (Figure 1).



Figure 1

Damage to underside of aircraft

Recorded information

Information obtained by the operator for flight data monitoring purposes showed that the aircraft started to rotate at about 143 kt and as the aircraft became airborne it reached an attitude of 11.95° nose up, attaining a peak pitch rate of 4.2°/second.

Takeoff data

A comparison between the incorrect and correct takeoff performance data is at Table 1.

	Incorrect performance data	Correct performance data
Takeoff weight (tonnes)	59	71.3
Assumed temperature (°C)	48	31
N_1 (%)	86.3	93.6
V_1	140 kt	152 kt
V_R	140 kt	153 kt
V_2	143 kt	157 kt

Table 1
Comparison of takeoff data

Operations manual

Part B of the operator's operations manual (OM) states:

'4.5 Using the On-board Performance Tool (OPT)[EFB]:

...

WARNING: The performance calculations must be performed independently by both pilots, each using its own EFB and the results (derate, assumed, take-off speeds) must be crosschecked for correctness calculation.

...

4.6 OPT for take-off

...

After computing independently, the OPT takeoff data, the crew shall perform a crosscheck of the results.

...'

Aircraft information

The manufacturer's flight crew training manual states that the 737-8's tailstrike pitch attitude is 11.0°. It also states the following:

'Rotation and Liftoff - All Engines

...

For optimum takeoff and initial climb performance, initiate a smooth continuous rotation at VR toward 15° of pitch attitude.

...

Using the technique above, resultant rotation rates vary from 2° to 3° per second with rates being lowest on longer airplanes. Liftoff attitude is achieved in approximately 3 to 4 seconds depending on airplane weight and thrust setting.'

Aircraft's Quick Reference Handbook

The aircraft's Quick Reference Handbook (QRH) checklist for a tailstrike states:

Tail Strike ()	
Condition: A tailstrike is suspected.	
Caution! Do not pressurize the airplane due to possible structural damage.	
1	Pressurization mode selector MAN
2	Outflow VALVE switch Hold in OPEN until the outflow VALVE indication shows fully open to depressurize the airplane
3	Plan to land at the nearest suitable airport.
■ ■ ■ ■	

Pilots' comments

Commander's comments

The commander commented that he was aware of the tailstrike checklist. He added that as they were not aware of the event there was no need to refer to it.

Co-pilot's comments

The co-pilot commented that on the takeoff the aircraft pitched up "aggressively" and a higher than normal pitch attitude was attained. He added he was not aware of the tailstrike checklist and in future will always ensure the commander crosschecks any performance calculations.

Analysis

During the pre-flight preparation, the commander read the ZFW from the load sheet to the co-pilot, instead of the TOW, and this was entered into the EFB. The takeoff performance data calculated consequently used a takeoff mass of about 12 tonnes less than the aircraft's actual weight. This produced takeoff speeds that were more than 10 kt less than those required. Having flown the takeoff using these slower speeds the aircraft suffered a tailstrike.

It was likely that the incorrect weight was read out, and not crosschecked, as the crew tried to meet the CTOT. However, had the co-pilot crosschecked the load sheet, as required by the operator's SOPs, it is likely this would have been noticed. Also, had each pilot done independent calculations, in accordance with the SOPs, any differing takeoff data would probably have been noticed too.

Shortly after takeoff ATC enquired if the aircraft had sustained a tailstrike; the pilots thought not, as they had no evidence to suggest it. Later, they discovered the error in the EFB and then spoke to the cabin crew member stationed at the rear of the aircraft who heard a strange noise during the takeoff. Despite noticing the EFB error and the other two anomalies from the takeoff, these facts did not cause the pilots any concern and the aircraft continued to destination, without reference to the QRH. However, the commander was likely to have realised that a tailstrike had occurred as he asked the engineers to examine the aircraft after landing.

The '*Tail Strike*' checklist is to be completed if one is '*suspected*'. The enquiry from ATC should have been enough for the pilots to refer to the QRH and take the prescribed actions. Having disregarded this, the additional anomalies should have increased the pilots' suspicion and given them cause to refer to the QRH. Had the QRH been actioned, the aircraft would probably have been able to return to Birmingham or diverted en route. Continuing to destination put the safety of the aircraft and its occupants at an increased risk.

Safety actions

As a result of this event the operator issued Safety Information Bulletin No 7/2018 to its pilots, highlighting the background to it and highlighted the following:

'The flight crew members are advised to strictly follow the provisions of OMB 4.6 "AFTER COMPUTING INDEPENDENTLY, THE CREW SHALL PERFORM A CROSSCHECK OF THE RESULTS",

When feeding the FMC with data that can affect performance or carrying out a correction, a cross-check shall be initiated before executing the task,

To take into consideration the importance of the information provided by the cabin crew and ATC,

QRH shall be used any time a non-normal situation occurs (i.e. NNC Tail Strike).'