

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 787-900, VH-ZND	
No & Type of Engines:	2 General Electric 1B P2G01/02 turbofan engines	
Year of Manufacture:	2018 (Serial no: 63390)	
Date & Time (UTC):	9 February 2020 at 1300 hrs	
Location:	London Heathrow Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 13	Passengers - 224
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Tail strike sensor damaged	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	52 years	
Commander's Flying Experience:	13,538 hours (of which 562 were on type) Last 90 days - 60 hours Last 28 days - 17 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

The aircraft was departing from Runway 27R at London Heathrow Airport (EGLL) in strong and gusty wind conditions. The surface wind passed by the Tower controller with the takeoff clearance was 220° at 28 kt gusting 44 kt. Shortly after aircraft rotation was initiated, variations in airspeed were experienced combined with larger than normal pitch control inputs on the Pilot Flying's (PF) control wheel, which resulted in the tail strike sensor contacting the runway surface.

History of the flight

The aircraft was on a scheduled flight from London Heathrow Airport to Perth Airport in Australia. Following a normal engine start and taxi, the aircraft was cleared for takeoff from Runway 27R with the surface wind reported as 220° at 28 kt gusting 44 kt. Acceleration was normal in the strong wind and, at V_R of 172 KIAS, the PF initiated a rotation which was coincident with a strong gust. Shortly after becoming airborne, the EICAS TAIL STRIKE message was displayed. The crew elected to hold to the southwest of Heathrow at 6,000 ft whilst they carried out relevant actions from the Quick Reference Handbook (QRH), which prevented aircraft pressurisation, so prepared to return to Heathrow. The aircraft was then radar-vectorred for an approach to Runway 27L at Heathrow, where an overweight landing was made.

Aircraft information

Tail strike protection system

The Boeing 787 is fitted with a tail strike protection system that automatically adjusts the position of the elevators so as to reduce the potential for tail contact with the ground during takeoff and landing. The system does not degrade takeoff performance.

Tail strike detection and alerting system

Tail strike detection is provided by a 2" blade sensor fitted to the rear lower fuselage of the aircraft (Figure 1). If the electrical circuit within the sensor is compromised due to contact with the ground, a TAIL STRIKE caution message is displayed on EICAS after five seconds. This is accompanied by an aural warning and master caution light being presented in the cockpit.



Figure 1
Tail strike sensor

Aircraft examination

After landing, it was identified that the tip of the tail strike detection sensor (Figure 2) had been abraded due to contact with the runway. No further damage was found.



Figure 2

Damage to aircraft tail strike sensor

Recorded information

Flight data was available from the aircraft's Continuous Parameter Logging (CPL)¹ system and FDR. Parameters included the aircraft's airspeed, the position of its wing spoilers, cockpit control columns and wheels, and pitch rate and tail height (which indicated the distance between the tail strike detection sensor and the ground). The aircraft manufacturer advised that due to factors including aircraft loading and runway slope, the tail height parameter may not always reach zero when the aircraft tail contacts the ground.

The aircraft was correctly configured for takeoff, with the flaps set to FIVE, and V_R was 172 kt.

The data showed that during the takeoff run, there were airspeed fluctuations consistent with the gusty wind conditions. Upon reaching an airspeed of 160 KIAS, the airspeed rapidly increased to 175 KIAS, at which point the PF initiated the rotate (Figure 3 - Point A).

Footnote

¹ The function of the CPL is similar to a Quick Access Recorder (QAR) in that it provides operators with data that may be wirelessly transmitted from the aircraft for use by a flight data monitoring program.

As the aircraft pitched up, the airspeed reduced to 172 KIAS, where it briefly stagnated (Figure 3 - Point B). The PF had progressively moved the control column aft to 4° (Figure 3 - Point C) at which point the pitch rate was just over 2°/s; the maximum aft movement of the control column was 9.8°. The control column was then moved slightly forward (Figure 4 - Point D) to 3°, but the pitch rate increased to 3.2°/s. The airspeed then started to increase, which coincided with the PF pulling back on the control column whilst also moving the control wheel from 20° counter-clockwise (CC) to 33° CC (Figure 3 - Point E). This caused the left spoilers to further deploy from 5° to 20°.

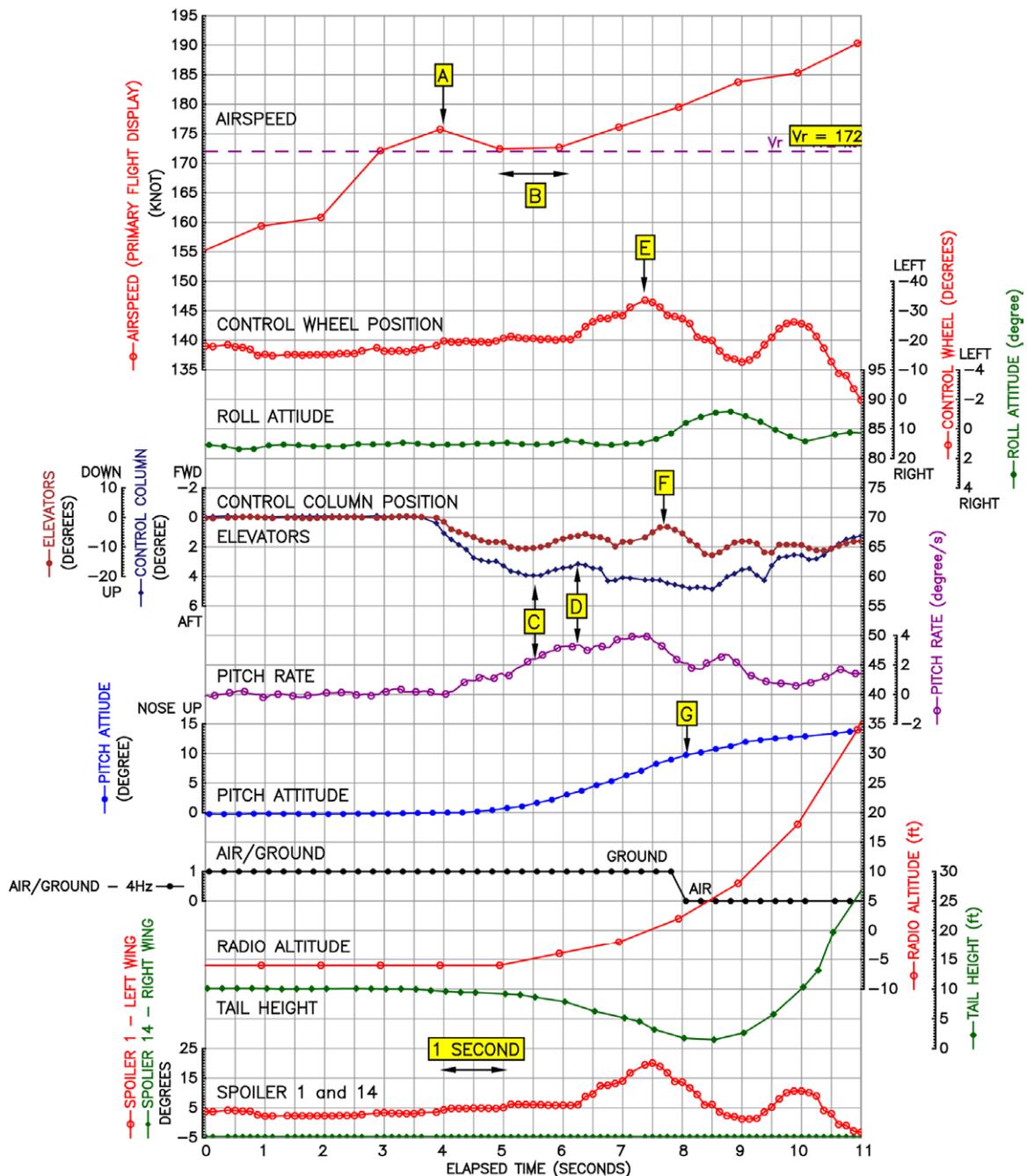


Figure 3
Salient flight data parameters

As the pitch attitude increased through 6.3° nose-up, the pitch rate was nearly 4°/s, and the calculated tail height above the runway was 4.5 ft. The aircraft's tail strike prevention system then started to move the elevators (Figure 3 - Point F), which reduced the pitch rate to just over 2°/s. The pitch attitude at takeoff was about 9.7° (Figure 3 - Point G) and the tail height indicated just less than 2 ft.

The aircraft manufacturer analysed the FDR and CPL data and stated:

'The near tail contact was the result of a combination of factors including: high pitch rate close to lift-off, airspeed stagnation, and control wheel usage deploying spoilers on the left wing. The high pitch rate allowed pitch attitude to increase towards the tail contact attitude prior to airspeed reaching lift-off speed. The deployed spoilers on the left wing decreased lift and necessitated a higher pitch attitude for lift-off.'

Weight and balance

The aircraft weight at takeoff was 253,400 kg, which was below the Maximum Take Off Weight (MTOW) permitted of 254,011 kg, with a CG position of 22.1% Mean Aerodynamic Chord (MAC). The forward limit at that weight, as shown on the load sheet, was 20.25% MAC with the aft limit 24.3%.

Meteorology

General situation

On 9 February 2020, Storm Ciara, which was the most severe storm of the 2019/2020 season, brought strong winds and heavy rainfall across the UK. At the time of the incident, an active occluded front was crossing the London Terminal Manoeuvring Area (LTMA), which included Heathrow, with intense rainfall and strong south-westerly winds.

London Heathrow Airport

METAR observations for Heathrow were obtained for the hours preceding the time of the incident. The observations showed generally south-westerly winds with mean speeds of 26 to 29 kt and gusts of 37 to 45 kt. The main cloud base was 1,400 to 1,500 ft, with outbreaks of rain reducing the visibility to 6 km at times. However, visibility lowered just after midday to 3,900 m with cumulonimbus cloud being detected in automatic observations.

The observation for 1250 hrs, closest to the time of the incident, indicated a mean wind speed of 27 kt from the southwest with gusts to 44 kt. The synoptic weather, which contains additional information, was obtained for 1300 hrs and 1400 hrs. It showed that the highest gusts in the preceding hour were 47 kt, easing slightly to 45 kt in the following hour. The surface chart is shown below at Figure 4.

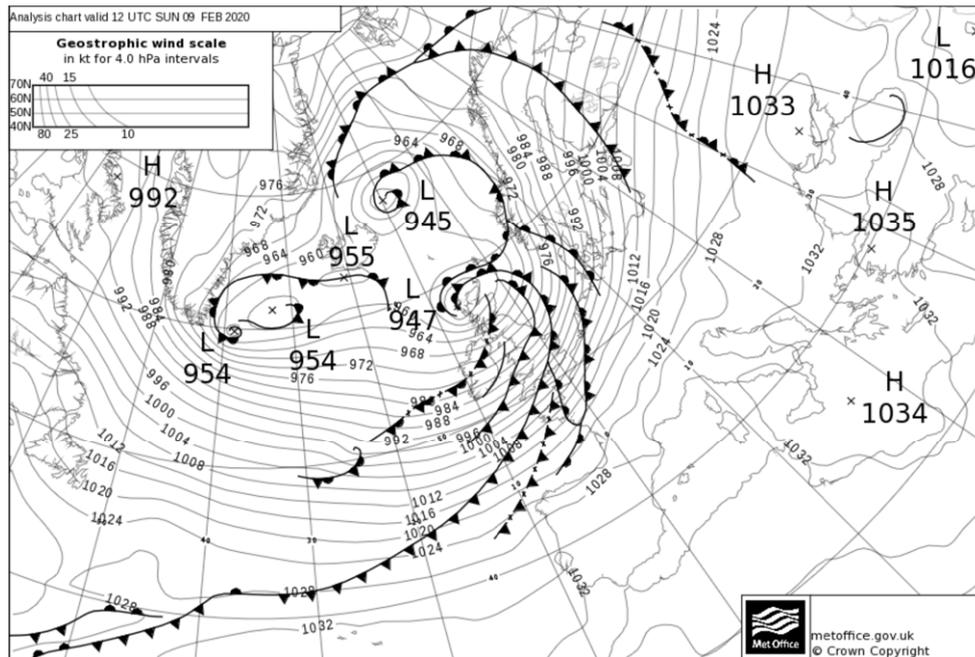


Figure 4

Surface analysis chart valid at 1200 hrs UTC on 9 February 2020

London Heathrow Airport METARs

091250Z EGLL EGLL 091250Z AUTO 22027G44KT 6000 -RA SCT015/// BKN 020///
OVC044/////////CB 12/11 Q0989 RERA TEMPO SHRA

091320Z EGLL EGLL 091320Z AUTO 22027G40KT 9999 -RA SCT015/// BKN022///
OVC044/////////CB 12/11 Q0988 NOSIG

Other information

Tail contact pitch angle

The pitch attitude for tail contact is 9.7° with wheels on the runway and landing gear struts extended. A normal lift off pitch angle is between 6° and 7.5° giving a minimum tail clearance height of 29 inches (74 cm). The normal tail clearance profile is shown at Figure 5 below.

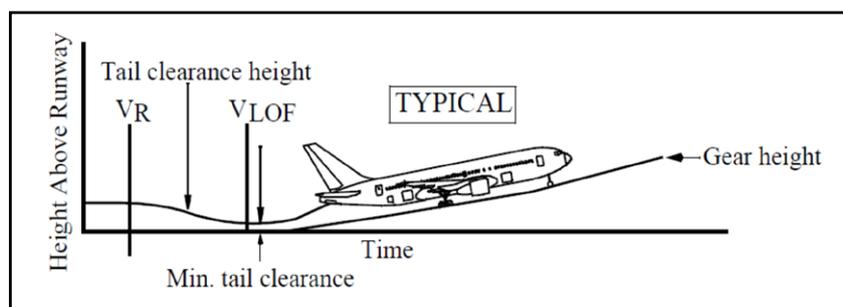


Figure 5

Normal tail clearance profile
(Boeing 787 Flight Crew Training Manual)

Action in the event of a tail contact

The action to be taken in the event of a tail strike being suspected or confirmed (such as the EICAS TAIL STRIKE message), is contained in the QRH. It involves ensuring the aircraft does not pressurise, and the flight crew should plan to land at the nearest available airport. The relevant text is shown at Figure 6 below.

Tail Strike

Condition: A tail strike is suspected or confirmed.

Caution! Continued pressurization of the airplane can cause further structural damage.

- 1 OUTFLOW VALVE switches (both) MAN
- 2 Use momentary actuation of the outflow valve manual switches to avoid large and rapid pressurization changes.
 ⚠ OUTFLOW VALVE MANUAL switches (both) Move to OPEN until the outflow valve indications show at the 12 o'clock position to depressurize the airplane
- 3 Plan to land at the nearest Available Airport.
- 4 Do **not** accomplish the following checklist:
 CABIN ALTITUDE AUTO
 ■ ■ ■ ■

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Figure 6

The QRH Tail Strike checklist

Analysis

The aircraft was being operated within its weight, CG and wind limitations for the takeoff. The weather conditions created strong gusting winds which, just before the point of rotation, rapidly increased the aircraft's airspeed from 160 KIAS to 175 KIAS. The initial pitch rate of 2°/s increased to 3.2°/s and then 4°/s, when the tail strike prevention system activated and reduced the pitch rate to 2°/s. The lateral control wheel inputs caused the left spoilers to deploy from 5° to 20°, decreasing the lift. The combined effect was that during rotation, an increase in aircraft pitch angle with the main landing gear wheels still on the runway, led to the tail contact angle of 9.7° being reached and the crew receiving an EICAS TAIL STRIKE message.

Having been alerted to the tail contact by the EICAS message, the flight crew actioned the QRH and prevented the aircraft pressurising. After holding, the aircraft was flown to Heathrow in accordance with the checklist.

Conclusion

During conditions of strong, gusty winds, a high pitch rate near lift-off caused the tail strike prevention system to activate. The tail contact angle was reached, and the crew received an EICAS TAIL STRIKE message.