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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2011-032
Final

Rejected takeoff, VH-EBL
Perth Airport, Western Australia
23 February 2011

Abstract

On 23 February 2011, an Airbus A330-203 aircraft, registered VH-EBL, was being operated by Qantas Airlines on a scheduled passenger flight from Perth, Western Australia to Sydney, New South Wales. During the latter part of the takeoff, the aircraft yawed suddenly and unexpectedly and the pilot in command rejected the takeoff. Following braking, smoke and some flame emitted from the main wheel area, but emergency services were not required to apply any extinguishing agent.

The investigation found that there was no aircraft-related problem and the unexpected aircraft yaw was probably due to a lateral wind gust.

No organisational or systemic issues that might adversely affect the future safety of aviation operations were identified. However, the occurrence does provide a timely reminder of the risks associated with rejected takeoffs at relatively high speeds, such as wheel fires. Pilot awareness of their potential exposure to sudden and unexpected lateral wind gusts during takeoff may increase the likelihood of pilots differentiating between a lateral jerk to the aircraft and the effect of an engine failure.

FACTUAL INFORMATION

Sequence of events

On 23 February 2011, an Airbus A330-203 aircraft, registered VH-EBL (EBL), was being operated by Qantas Airlines on a scheduled passenger flight from Perth to Sydney. On board the flight were 10 crew and 181 passengers.

At 1529 Western Standard Time[1], the pilot in command (PIC), as the pilot flying, applied engine power during the turn onto runway 03 to commence a rolling takeoff from taxiway 'Lima'. The nominated V_1[2] for the takeoff was 123 kts.

The flight crew reported that the takeoff proceeded normally with hardly any rudder corrections required until just after the aircraft speed passed 100 kts. The PIC recalled that there was a sudden and unexpected sharp yaw that felt like an engine failure and that he instinctively corrected the yaw with rudder and rejected the takeoff. Unlike an engine failure, there was little resistance to the rudder application, and a look at the engine indications by the flight crew showed no indication of an engine failure.

Once the rejected takeoff was initiated, however, the PIC was committed to it. The autobrakes rapidly decelerated the aircraft and the PIC applied reverse thrust for a short period of time. The autobrakes were released at about 30 kts and the aircraft was slowed to a stop on the runway initially, and then taxied onto the adjacent taxiway 'Delta'.

1 Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

2 V_1 is the critical engine failure speed or decision speed. Engine failure below this speed should in most circumstances result in a rejected takeoff; above this speed the take-off run should be continued.

The tower controller advised the crew of smoke coming from the area of the aircraft's main landing gear and advised the aerodrome rescue and fire flighting (ARFF) control centre. Control centre personnel had also observed the smoke and were already in the process of deploying vehicles and personnel to the aircraft.

The fire station manager, who happened to be on the domestic terminal apron at the time, reported to the responding fire commander that there was fire coming from the aircraft's left main wheels. The fire commander requested and received a clearance from air traffic control for the ARFF vehicles to proceed to the aircraft, where they parked in a tactical position to the rear (upwind) and left (priority side) of the aircraft.

The flames from the left wheels were not sustained and ARFF personnel monitored the landing gear until cooling fans that were deployed by the operator's engineers, cooled the wheels to a safe temperature. No extinguishing agent was dispensed.

Ground crew towed the aircraft to the domestic terminal. No injuries were reported and no aircraft damage was recorded.

Pilot information

The PIC held an Air Transport Pilot (Aeroplane) Licence with a total of about 19,000 hours flying experience, including 5,000 hours on the Airbus A330 type.

Aircraft information

When the flight was dispatched, there were no reported or recorded aircraft defects. Maintenance inspections carried out after the rejected takeoff did not identify any faults that could have contributed to the sudden yaw.

Meteorological information

The aerodrome forecast (TAF)[3] for Perth Airport predicted the wind to be from 080°(T) at 13 kts with no significant weather.

The 1530 routine weather report (METAR)[4] for Perth Airport recorded the wind from 100°(T) at 14 kts with no significant weather. The temperature was 34 °C.

One-minute wind data for Perth Airport at 1529 was recorded as from 084°(T) at 6 kts. There was no significant variation in the recorded wind strength or direction immediately before or after the commencement of the takeoff at 1529.

The flight crew and tower controller did not observe any unusual wind disturbances during the take-off/rejected take-off sequence.

Aerodrome information

The declared runway distance for takeoff from taxiway Lima was 2,535 m. Taxiway Delta, where the aircraft stopped after the rejected takeoff, was 764 m from the end of runway 03.

Data about aircraft movements on runway 03 before the rejected takeoff was requested from the air traffic services provider, but was unavailable.

Recorded data

The aircraft was equipped with a cockpit voice recorder (CVR) that was designed to record over 2 hours of audio. The Australian Transport Safety Bureau (ATSB) downloaded the CVR data, which was found to include the rejected takeoff sequence.

The aircraft was also equipped with a digital flight data recorder (DFDR) that was designed to record over 25 hours of flight data covering about 1,000 parameters. The ATSB obtained a copy of the DFDR data for the occurrence and examined the parameters relevant to the rejected takeoff. A plot of the relevant data is at Appendix A.

The data for the takeoff showed only minor variations in lateral load factor until the aircraft reached a groundspeed of 111 kts at 1529:49. At that time, the lateral acceleration to the left began to increase without any significant left rudder input or engine power asymmetry. One second later, at a groundspeed of 115 kts (213 km/h) and with the acceleration to the left still increasing, right rudder was applied by the PIC.

3 A forecast that is issued at routine intervals and provides a statement of the meteorological conditions expected for a specified period in the airspace within a radius of 5 NM (9 km) of the centre of the aerodrome's runway complex.

4 Routine aerodrome weather report issued at fixed times, hourly or half-hourly.

The aircraft yawed to the right in response. Left rudder was applied and both engines were reduced to idle before the selection of reverse idle thrust at 0729:52. Shortly after the brakes were applied, the ground spoilers deployed and reverse thrust was momentarily applied.

Analysis of the DFDR data by the French investigation agency, the Bureau d'Enquêtes et d'Analyses (BEA) identified a variation in the values and direction of the left and right angle of attack parameters at the time of the initial lateral acceleration. This was considered by the BEA to be the result of a 'right lateral wind gradient' (gust).

Parameters such as nosewheel steering order, nosewheel angle, throttle lever position, brake pressure and engine N_1[5] were reviewed and found not to have any anomalous indications.

Other information

Operating procedures

The aircraft operator's A330 Flight Crew Operating Manual (FCOM) included operating techniques for a rejected takeoff.

The manual stated that when the aircraft speed was at or above 100 kts, it may become hazardous to reject a takeoff. In that case, the PIC should be 'Go-minded' as the aircraft speed approached V_1, unless a major failure such as a fire warning or sudden loss of engine thrust occurred. At or above V_1, the takeoff was to be continued because it may not be possible to stop the aircraft on the remaining runway.

The rejected take-off procedure was for the PIC to call 'STOP' and simultaneously retard the thrust levers to IDLE and engage maximum available reverse thrust. If there was sufficient runway remaining, it was preferable to reduce reverse thrust as the speed reduced below 70 kts.

Aircraft manufacturer bulletin

In September 2004, the aircraft manufacturer published FCOM Bulletin No 815/1 to address yaw disturbances during the take-off roll. Up to that time, various operators had reported about 30 events involving unusual yaw movement in A330 aircraft during the take-off roll. Described by some pilots as a 'lateral jerk', the most significant of those events was an initial sharp lateral disturbance associated with short, but substantial, lateral acceleration and heading variation. In most cases, the pilot took immediate action to correct the deviation and induced a lateral acceleration peak in the opposite direction.

The manufacturer analysed recorded data from the reported events and additional data collected from a test aircraft, which experienced a similar event. That data analysis demonstrated that the lateral perturbations were not caused by an aircraft system malfunction, but were due to localised external lateral gusts of wind. The manufacturer's bulletin concluded that such effects were most likely produced by thermals or thermal vortices that can often develop in hot, dry conditions.

The bulletin included a typical DFDR trace of acceleration, groundspeed, heading and rudder inputs that had the same features as the DFDR trace of these parameters for the rejected takeoff involving EBL.

ANALYSIS

The recorded information showed that the aircraft sustained a sudden and unexpected movement to the left at 115 kts during the take-off roll. Although the movement was sensed by the pilot in command (PIC) as being similar in feel to that experienced after an engine failure, the engine indications were normal and there was no asymmetry of thrust such as would be associated with such a failure.

There was no recorded data or pilot account to indicate that aircraft-related factors, such as a sudden rudder deflection, asymmetric braking or a nosewheel steering anomaly had contributed to the disturbance.

The investigation concluded that an aircraft-related problem was not a factor.

Potential environmental factors such as wind gusts created by a crosswind, local or aircraft wake turbulence were considered. In that context, the recorded variation between the aircraft's left and right angle of attack sensors at the time of

5 Fan or engine low pressure compressor speed.

the disturbance was consistent with the effects of a lateral wind gradient.

In the absence of any aircraft-related problem, and with the indirect evidence of a lateral wind gradient and the correlation between the recorded data in this case and other similar events, the investigation concluded that the disturbance was likely to be the wind-related lateral jerk phenomenon identified by the aircraft manufacturer.

The PIC, however, suspected that the lateral jerk was symptomatic of an engine failure and rejected the takeoff. With the aircraft between 100 kts and V_1 at the time, that decision was consistent with the guidance provided by the operator in the Flight Crew Operating Manual.

The investigation did not identify any organisational or systemic issues that might adversely affect the future safety of aviation operations. However, the occurrence does provide a timely reminder of the risks associated with rejected takeoffs at relatively high speeds, such as wheel fires. Pilot awareness of their potential exposure to sudden and unexpected lateral wind gusts during takeoff may increase the likelihood of pilots differentiating between a lateral jerk and the effect of an engine failure.

FINDINGS

From the evidence available, the following findings are made with respect to the rejected takeoff that occurred at Perth Airport, Western Australia on 23 February 2011 and involved Airbus A330-203 registered VH-EBL. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The pilot in command rejected the takeoff due to a sudden and unexpected yaw that was initially identified as an engine failure, but was later found to be the effect of a lateral wind gust (lateral jerk).

Other key findings

- Emergency services responded to flame and smoke from the wheels, but were not required to dispense any extinguishing agent.

SOURCES AND SUBMISSIONS

Sources of Information

The sources of information during the investigation included the:

- aircraft operator
- flight crew
- aircraft manufacturer
- French investigation agency, the Bureau d'Enquêtes et d'Analyses (BEA).

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1)(a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the aircraft operator and flight crew, the aircraft manufacturer, the BEA and the Civil Aviation Safety Authority.

Submissions were received from the aircraft operator, the flight crew and the BEA. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

APPENDIX A: DIGITAL FLIGHT DATA RECORDER PLOT