Australian Government
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Significant wind change during takeoff involving Boeing 737, VH-VZL

Perth Airport, Western Australia, 4 December 2012

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Significant wind change during takeoff involving Boeing 737, VH-VZL

What happened

On 4 December 2012, at about 1618 Western Standard Time[1], a Qantas Airways Boeing 737-838 aircraft, registered VH-VZL (VZL), was taking off on runway 06 at Perth Airport, Western Australia on a flight to Canberra, Australian Capital Territory. The captain was the pilot not flying and the first officer was the pilot flying.

During the take-off run, approaching the take-off reference speeds[2] of V_1[3] and V_R[4], the airspeed stopped increasing and did not start increasing again for several seconds. The captain noticed that the wind vector on the navigation display was showing a tailwind[5] of about 20-25 kt. The captain disconnected the auto-throttle and 'fire-walled'[6] the thrust levers. During the initial climb, the first officer performed a windshear[7] escape manoeuvre.[8]

While there was some cumulonimbus cloud[9] activity about 20–30 NM north of the airport, there were no indications of an impending wind change before takeoff.

After takeoff, the crew advised air traffic control (ATC) that they had experienced a significant tailwind component of about 20 kt during the take-off run. ATC advised the next aircraft due to depart from runway 06 that there was now a threshold wind of 060°T at 10 kt and a centre-field wind of 280°T at 15 kt. Takeoffs were then temporarily suspended from runway 06 and aircraft departed using runway 03.

Automatic terminal information service (ATIS)[10]

ATIS 'Delta', issued at 1613:12, was current and monitored by the crew before the aircraft lined-up for takeoff. This gave the wind direction as 060°M and the wind speed as 8 kt. For a takeoff on runway 06 this was a direct headwind of 8 kt. The temperature was 37°C and conditions were CAVOK[11].

Take-off performance

The aircraft was equipped with two CFM56-7B24/3 engines, which enabled takeoffs to be planned up to a maximum thrust of 24,200 lbs (24K). In addition, during takeoff, there was a 'take-off bump' feature where 'fire-walling' the thrust levers could temporarily provide 27,300 lbs (27K) thrust irrespective of whether a 24K thrust setting had been selected.

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

2 Take-off reference speeds or V speeds assist pilots in determining when a rejected takeoff can be initiated, and when the aircraft can rotate, lift off and climb.

3 V_1: the critical engine failure speed or decision speed. Engine failure below this speed shall result in a rejected takeoff; above this speed the take-off run should be continued.

4 V_R: the speed at which the aircraft rotation is initiated by the pilot.

5 Although the wind data displayed on the navigation display is considered to be inaccurate while the aircraft is on the ground, it can still give an indication of whether there is a headwind or tailwind component.

6 The thrust levers were pushed forward to their mechanical stops.

7 Windshear is a change of wind speed and/or direction over a short distance along the flight path.

8 The windshear escape manoeuvre is a memory item which required the flight crew to carry out the procedure from memory.

9 Thunderstorms are associated with cumulonimbus cloud.

10 ATIS: An automated pre-recorded transmission indicating the prevailing weather conditions at the airport and other relevant operational information for arriving and departing aircraft.

11 CAVOK: ceiling and visibility OK, meaning that visibility, cloud and present weather were better than prescribed conditions. For an aerodrome weather report, those conditions are visibility 10 km or more, no significant cloud below 5,000 ft or cumulonimbus cloud and no other significant weather within 9 km of the aerodrome.

An electronic flight bag (EFB) was used by the crew for take-off performance calculations. For an aircraft gross take-off weight of 66.1 tonnes, nil wind and an air temperature of 37°C, a takeoff on runway 06 could be performed using a 24K thrust setting, no assumed temperature[12] and a flap setting of 5 degrees. The take-off speeds V_1, V_R and V_2[13] were 137, 139 and 144 kt respectively.

Windsocks

There were three windsocks at Perth Airport (Figure 1); however, there was no windsock near the threshold of runway 06. Before takeoff, the captain observed that windsock 1 was indicating a headwind component. The first officer also confirmed that windsock 2 was showing a headwind component. Any headwind component was acceptable for takeoff as the performance figures had assumed nil wind.

Figure 1: Take-off path and windsock locations

Source: Google Earth

Onboard windshear detection systems

The aircraft was equipped with predictive and reactive windshear detection systems. The predictive system used the aircraft's weather radar system to detect windshear prior to the aircraft

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[12] An assumed temperature is a temperature higher than ambient, which causes the engine control system to reduce the amount of thrust the engines deliver, thereby reducing the wear on the engines.

[13] V_2: the minimum speed at which a transport category aircraft complies with those handling criteria associated with climb, following an engine failure. It is the take-off safety speed and is normally obtained by factoring the stalling speed or minimum control (airborne) speed, whichever is the greater, to provide a safe margin.

entering the windshear and automatically began scanning when the thrust levers were set for takeoff. New warnings were inhibited after the aircraft reached 100 kt until it was over 50 ft above ground level.

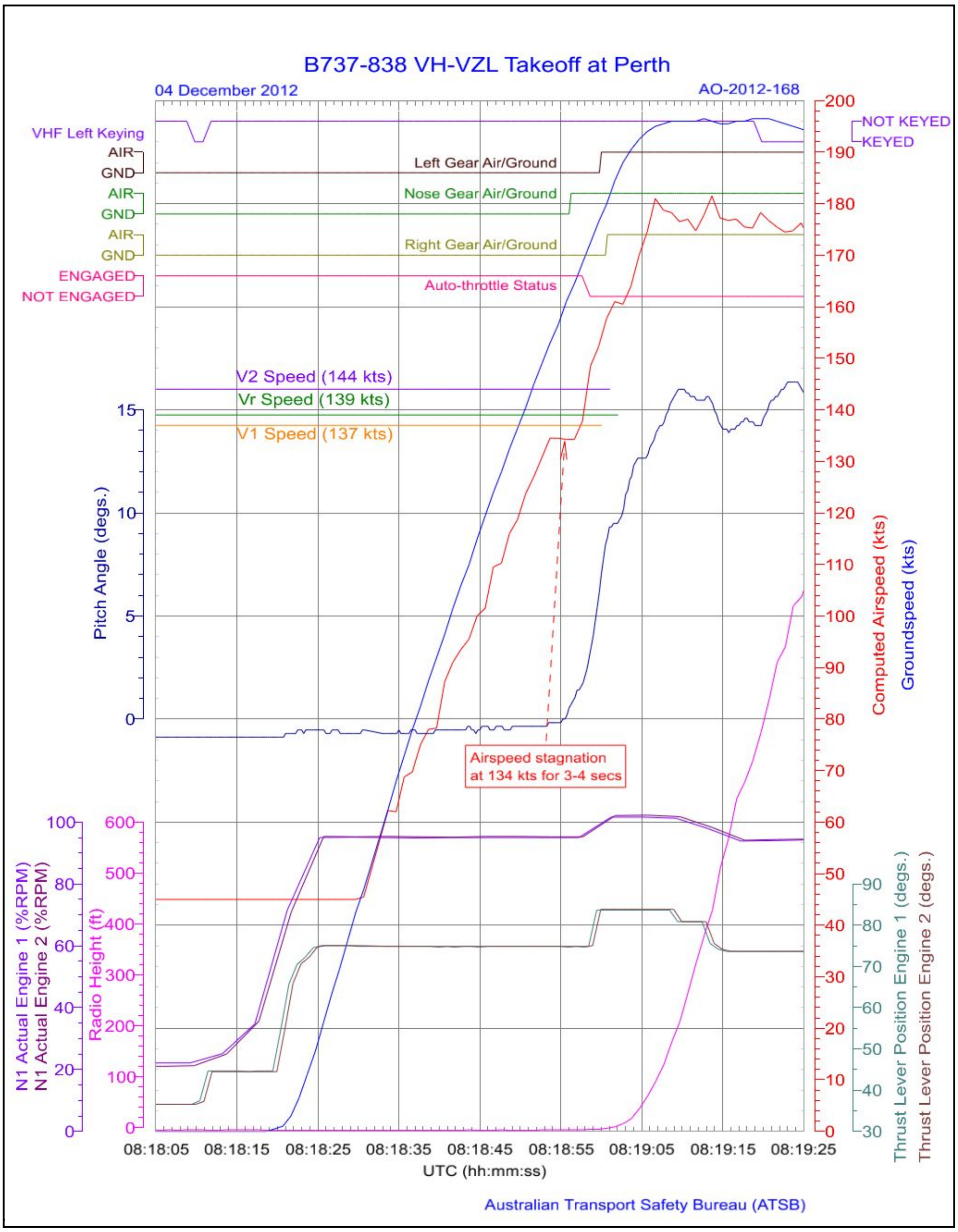
The reactive system used the aircraft's ground proximity warning system to detect when the aircraft was actually experiencing windshear. Detection began at rotation.

No windshear warnings were received by the crew.

Recorded flight data

Quick access recorder (QAR) data was obtained from the operator and analysed by the ATSB (Figure 2). The data showed that the airspeed stagnated[14] at 134 kt for 3-4 seconds just below the V_1 speed of 137 kt, the auto-throttle was disconnected and maximum thrust was set.

Figure 2: QAR data



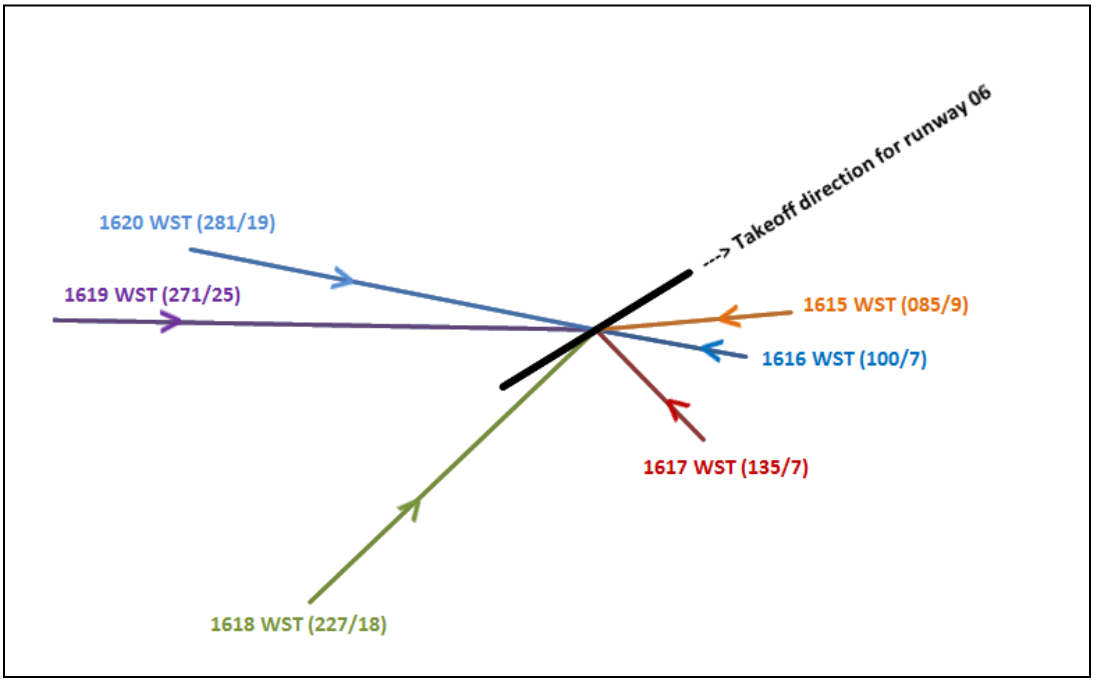
14 The airspeed was a function of groundspeed and wind speed/direction. As the groundspeed was smoothly increasing, any airspeed fluctuations were a result of wind speed/direction fluctuations.

Just after the aircraft became airborne, the wind was recorded at 282°T and 25 kt. No windshear warnings were recorded. Recorded latitude, longitude and radio altitude data showed that the aircraft passed over the end of runway 06 (threshold of runway 24) at a height of about 10 ft above ground level.

Recorded wind information

The Bureau of Meteorology (BoM) provided one minute wind readings from their airport anemometer. The anemometer was located near the northern end of runway 06 (Figure 1). The maximum wind gusts during the one minute periods around the time of takeoff are shown to scale in Figure 3. The wind direction value is averaged over a one minute period. Wind values are given in wind direction/wind speed format in units of °T/kt.

Figure 3: BoM anemometer data – maximum wind gusts



Source: BoM

The anemometer experienced a significant wind change at 1618 that would have resulted in tailwind conditions at least near the northern part of runway 06.

ATSB comment

Before takeoff, both pilots checked the windsocks, which showed that headwind conditions existed. Late in the take-off run, a significant wind change occurred and the aircraft began to experience tailwind conditions of about 20 kt. As the performance calculations had assumed nil wind for takeoff, the aircraft failed to achieve the predicted take-off performance.

Safety message

This incident serves as a reminder to pilots that significant wind changes can occur during takeoff, can be difficult to predict, and can occur in the absence of thunderstorm activity. The wind conditions at each end of a runway may differ significantly so that headwind conditions can exist at one end and tailwind conditions at the other end.

Although it did not assist in this case, it is important to monitor the available windsocks before takeoff as it is the final opportunity to detect wind changes before the take-off roll begins.

The Flight Safety Foundation, approach and landing accident reduction toolkit contains information on awareness, avoidance and recognition of windshear, as well as recovery procedures. It is available at; http://flightsafety.org/files/alar_bn5-4-windshear.pdf

Aircraft details

Manufacturer and model:	The Boeing Company 737-838	
Operator:	Qantas Airways	
Registration:	VH-VZL	
Type of operation:	Air transport - high capacity	
Location:	Perth Airport, Western Australia	
Occurrence type:	Environment - weather	
Occurrence category:	Serious incident	
Persons on board:	Crew – 7	Passengers – 99
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.