

**Aviation Safety Investigation Report
199500460**

**Boeing Co
B737-400**

20 February 1995

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NOTE: All air safety occurrences reported to the ATSB are categorised and recorded. For a detailed explanation on Category definitions please refer to the ATSB website at www.atsb.gov.au.

Occurrence Number: 199500460 Location: 16km N Sydney State: NSW Date: Monday 20 February 1995 Time: 0830 hours Highest Injury Level: None	Occurrence Type: Incident Inv Category: 3 Time Zone: ESuT
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Aircraft Manufacturer: Boeing Co Aircraft Model: 737-476 Aircraft Registration: VH-TJK	Serial Number: 24436
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Type of Operation: Air Transport Domestic High Capacity Passenger Scheduled Damage to Aircraft: Nil Departure Point: Melbourne VIC Departure Time: Destination: Sydney NSW	
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Approved for Release: Wednesday, October 11, 1995

Boeing B737-476, VH-TJK, was being radar vectored onto the Sydney 16R localiser from the right, to follow a B747-438 already established on the localiser. The pilot in command was flying the aircraft with autopilot "A" engaged, heading mode selected, and VOR/localiser capture mode armed. The aircraft turned onto the localiser, descending through an altitude of 2,500 ft, some 2.3 dots below the glideslope, about 10 NM from the landing threshold. As the B737 began to intercept the localiser track, maintaining an airspeed of about 218 kts, the bank angle was progressively increased to 29.5 degrees before the aircraft abruptly rolled further to the right. This uncommanded event coincided with initiation of trailing edge flap and leading edge slat extension from the stowed position. The aircraft reached a maximum bank angle of 62.9 degrees before the roll was stopped and the wings levelled by the handling pilot. A missed approach was carried out, after which the aircraft was landed normally without further incident. At the time of the occurrence the surface wind was 210 degrees at 10-15 kts, with scattered cloud at 1,800 ft and light rain in the area.

VH-TJK immediately underwent an extensive ground inspection program, followed by a flight test, in accordance with recommendations from the manufacturer. No defects were found which could have contributed to the occurrence.

An examination was carried out of recorded radar data, and of information derived from the flight data recorders of VH-TJK and the preceding B747. It was found that the B747 had intercepted the 16R localiser at an altitude of 3,000 ft, approximately 11 NM from the landing threshold. The aircraft maintained 3,000 ft until intercepting the glideslope at about 9.5 NM, and carried out what appeared to be a normal ILS approach to runway 16R. There was no reported turbulence.

VH-TJK intercepted the localiser at about 10 NM from the landing threshold, some 500 ft lower and about 115 seconds later than the B747 had been at the same lateral position. Recorded wind data from the inertial reference systems of both aircraft indicated the wind direction varied between 155 and 165 degrees, at a velocity of 25-35 kts. As the localiser track is 155 degrees, this meant there would have been little or no lateral displacement of any wake vortices produced by the B747.

Research has shown that for a typical jet transport aircraft, the wake descends behind the generating aircraft at approximately 300-500 ft/min for about 30 seconds. The descent rate decreases and eventually approaches zero at 500-900 ft below the flight path. The decay process of the wake is complex and is strongly influenced by atmospheric conditions (Boeing Airliner/Jan.-Mar. 1995). UK CAA wake turbulence studies have also shown that B747 and B757 aircraft produce higher Category A incident rates than other aircraft, where Category A incidents correspond to the development of uncommanded roll angles 30 degrees or greater to following affected aircraft. The same studies showed that aircraft with the highest incident rates of encountering wake turbulence behind B747 and B757 aircraft were BAC-111, B737 and DC9 types.

CAA wake turbulence radar separation standards are described in the Australian Manual of Air Traffic Services, and are based on three categories determined from the maximum certified take-off mass of the aircraft. B747 aircraft are categorised as heavy, while B737 aircraft fall into the medium category. The standard, which is based on distance, shall be applied when an aircraft is crossing behind, or operating within 0.5 NM laterally of another aircraft's flight path at the same level or less than 1,000 ft below. In this case, a medium behind a heavy required a minimum separation of 5 NM. Examination of the recorded radar data showed that the separation between VH-TJK and VH-OJC was approximately 5 NM at the time of the occurrence.

The recorded trailing edge flap and leading edge slat data for VH-TJK indicated that the uncommanded roll occurred whilst the devices were extending from their fully stowed positions. It was not possible to determine from the recorded data whether this was responsible for the uncommanded roll or contributed to its severity. However, ground inspections and subsequent flight testing did not reveal any defect in the operation of those systems.

It is therefore considered that the onset of the uncommanded roll resulted from an encounter with wake turbulence generated by the preceding B747.

Significant Factors

1. Atmospheric conditions were conducive to the slow decay of wingtip vortices generated by the preceding B747.
2. VH-TJK intercepted the localiser some 500 ft below the altitude of the preceding B747.
3. The maximum longitudinal spacing between VH-TJK and the preceding B747 was 5 NM.