
Uncommanded yaw on takeoff, Boeing 737-73V, G-EZJR

Micro-summary: This Boeing 737-73V experienced an uncommanded transient yawing moment on takeoff.

Event Date: 2003-04-08 at 1430 UTC

Investigative Body: Aircraft Accident Investigation Board (AAIB), United Kingdom

Investigative Body's Web Site: <http://www.aaib.dft.gov/uk/>

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INCIDENT

Aircraft Type and Registration:	Boeing 737-73V, G-EZJR	
No & Type of Engines:	2 CFM56-7B20 turbofan engines	
Year of Manufacture:	2002	
Date & Time (UTC):	8 April 2003 at 1430 hrs	
Location:	Runway 08, Luton Airport, Bedfordshire	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew - 5	Passengers - 119
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	37 years	
Commander's Flying Experience:	4,800 hours (of which 1,800 were on type) Last 90 days - 126 hours Last 28 days - 53 hours	
Information Source:	AAIB Field Investigation	

History of flight

The crew reported for duty at Belfast Aldergrove Airport at 1135 hrs for a series of six sectors, shuttling between Belfast and Luton. The first flight went without incident and after a normal turn around the crew departed the stand at Luton at 1412 hrs for the return sector, with the commander acting as handling pilot.

Runway 08 was in use and whilst taxiing from the apron the pilots completed the flight control checks in accordance with company procedures. These involved the commander displacing the rudder pedals to full deflection in both directions whilst the co-pilot followed through on his own pedals, both pilots checking for full and free movement. The co-pilot then displaced the control wheel and control column in both directions, again to check for full and free movement. These control checks were completed without problem.

After an uneventful taxi to the runway the aircraft was cleared to enter, backtrack and line up on Runway 08; it was then cleared for takeoff. The take-off run was normal until the commander raised the nosewheel off the ground during rotation when the crew stated that the aircraft suddenly jolted to one side, although they could not remember which way. The aircraft rapidly became airborne and the commander continued with the departure as the aircraft appeared to be handling perfectly normally once more. Once the after take-off checks were complete, the two pilots discussed the jolt and consulted the aircraft's checklist. However, as the aircraft was now apparently operating perfectly normally, the checklist did not contain any relevant drill for them to follow. Finally, the commander contacted the Senior Cabin Crew Member (SCCM) who informed him that from the cabin, the jolt had been sufficiently severe to lead the SCCM to believe that the aircraft was about to deviate off the runway.

Unable to find a cause for the disturbance during takeoff, but believing they had experienced some sort of uncommanded rudder event, the commander spoke with the company operations staff by radio. They in turn contacted the engineering department who advised that the aircraft should return to Luton for inspection. The aircraft was levelled at FL330 and given radar vectors to return to Luton. The commander briefed for the approach and landing and both pilots revised the immediate action items for an uncommanded rudder input in case they experienced another disturbance. The commander stated that he also added an additional 10 kt to the approach speed to give an increased margin of control. Having done this, the flight crew carried out a normal landing back at Luton and taxied to a stand where the aircraft was shut down.

Aircraft examination

Once the aircraft had arrived back at Luton the operator's engineers performed a thorough examination of the aircraft's systems. They also carried out the instructions contained in the aircraft manufacturer's Service Letter 737-SL-27-110, dated 20 August 1996, entitled '*Unexpected roll and yaw event troubleshooting*'. No faults relevant to this incident were found. The aircraft was released back into service the following day and, to date, no similar events have occurred.

Flight Data Analysis

Analysis of the recorded flight data indicated that the main yaw damper had been engaged at the time of the incident and that during ground taxiing manoeuvres prior to takeoff, including the final turn on to Runway 08, the rudder deflection opposed the initial change in aircraft heading. The rudder control yaw damper command could also be seen to be providing inputs to the rudder to oppose the achieved yaw rate. These activities indicated that the yaw damper was operative and responding in the correct sense. Additionally, the rudder pedal force and the rudder angle during the pre-take-off

control checks were examined in relation to the rudder pedal position. Again, these data showed that the rudder control circuit was functioning normally prior to takeoff.

Further study of the recorded flight data indicated there were small deviations in heading as the aircraft accelerated during the take-off ground roll, with corresponding small corrective rudder inputs. When the aircraft was at an airspeed of about 128 kt a lateral acceleration to the right occurred, reaching a peak of 0.21 g. There was no input from the rudder or any other aircraft control to initiate this lateral acceleration. The aircraft's heading deviated to the right at a calculated rate of about 1°/sec. The yaw damper responded by applying corrective left rudder when the lateral acceleration to the right was initiated, and the pilot also applied a corrective left pedal input at about the same time. These actions prevented further deviation to the right and restored the aircraft's original track. The initiation of the large lateral acceleration occurred whilst all wheels were in contact with the runway and before the aircraft was rotated to get airborne. The aircraft was rotated to get airborne at about 133 kt which coincided with the maximum recorded value of lateral acceleration. About 3 seconds after getting airborne, at an airspeed of about 142 kt, the aircraft banked about 5° to the left but this was corrected with lateral control.

Finally, a study of the engine parameters indicated that the engines were delivering symmetric thrust and similarly, a check of the brake pressure parameters did not reveal any indication of anomaly.

External Factors

In the absence of any evidence of a cause relating to the aircraft or inputs to its flying controls, the investigation focussed on external influences that might have induced the rapid deviation during takeoff.

Weather

The weather at the time of the incident was good with a light wind of 7 kt varying in direction through 40° either side of the runway. Visibility was above 10 km with scattered fair weather cumulus cloud at 4,800 feet. With such benign conditions, no weather phenomena could be identified that might have induced the required lateral loading on the aircraft to cause the event.

Jet Blast

There is a runup bay to the left of Runway 08 about two-thirds of the way down its length, at about the point where the aircraft would have rotated. Checks revealed, however, that no

aircraft had been using the bay at the time of the incident and jet blast can therefore be discounted as a possible cause.

Wake Turbulence

The previous runway movement prior to the incident had been a takeoff by the same aircraft type operated by the same company. ATC records showed an interval of three minutes between the preceding aircraft's departure and the departure involving the lateral disturbance. Both aircraft were of a similar take-off weight with load sheets showing the first to be 164 kg lighter than the second. Since they were using the same performance data, it is likely that they rotated at about the same point on the runway.

The light wind conditions at the time would have resulted in the vortices generated by the first aircraft's takeoff taking some time to disperse. It is also possible that the direction in which they dispersed could have been affected by the varying wind direction, possibly blowing them across the path of the following aircraft.

ICAO guidance on wake turbulence lays down no minimum separation time required between two Boeing 737 aircraft when taking off from the same runway. This suggests that any wake turbulence encountered by the following aircraft would not cause any significant control problems.

Conclusion

The evidence available provided no definitive cause for the aircraft's sudden and isolated yaw divergence during its take-off run. Objective evidence collected from the aircraft suggests the cause to be due to external influences but no likely influence was identified. Consequently, it was concluded that the jolt experienced by the crew during takeoff was caused by an unspecified atmospheric disturbance acting upon the aircraft at the point of rotation.