
Tire failure and RTO, McDonnell Douglas DC 10-30, PP-VMD

Micro-summary: This McDonnell Douglas DC 10-30 experienced a tire failure and RTO.

Event Date: 1997-02-08 at 2227 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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McDonnell Douglas DC 10-30, PP-VMD

AAIB Bulletin No: 7/97 Ref: EW/C97/2/1 Category: 1.1

Aircraft Type and Registration:	McDonnell Douglas DC 10-30, PP-VMD
No & Type of Engines:	3 CF6 turbofan engines
Year of Manufacture:	1975
Date & Time (UTC):	8 February 1997 at 2227 hrs
Location:	London Heathrow Airport
Type of Flight:	Scheduled Passenger
Persons on Board:	Crew - 18 - Passengers - 127
Injuries:	Crew - None - Passengers - None
Nature of Damage:	No 7 and 8 wheels and tyres badly damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	50 years (approximately)
Commander's Flying Experience:	14,000 hours (of which 4,500 were on type) Last 90 days - 60 hours Last 28 days - 20 hours
Information Source:	AAIB Field Investigation

History of Flight

The aircraft involved in this accident arrived at London Heathrow Airport from Rio de Janeiro earlier the same day at 1233 hrs. On arrival it was parked at Gate H30 and later towed to its departure Gate H5 at 1945 hrs. At 2207 hrs the flight was cleared for engine start and push-back and it commenced taxiing to Runway 27R nine minutes later. The taxi route to the runway took the aircraft directly onto the outer taxiway and then onto Runway 23 which it backtracked. The total time spent taxiing was approximately nine minutes.

The flight destination was São Paulo, Brazil and, due to the length of the flight, two flight deck crews were on board. The crew had arrived two days previously and, for the departure, consisted of a Captain in the left hand seat, who was undertaking a conversion from a different aircraft type, and a training Captain in the right hand seat who was the designated aircraft commander. The Captain under training was the handling pilot.

The weather at the time of the take off comprised a wind of 220°/4 kt, visibility 6 km in mist, temperature 5°C and dew point 4°C with a QNH of 1028 mb: the sky was clear. On arrival at the holding point for Runway 27R, the flight was cleared by ATC to line up after the departure of a previous aircraft which was already on the runway. At 2225 hrs the flight was cleared for take off.

The aircraft was at its maximum certificated weight of 256,000 kgs for take off and maximum thrust was used with a 15° flap setting. No 3 engine thrust reverser was locked out for this flight for technical reasons and this was permitted under the terms of the Minimum Equipment List for the type. The autobrake was selected to the rejected take off mode (RTO). V_1 had been calculated as 164 kt.

Initial acceleration for take off was normal until a speed of approximately 130 kt was reached when a loud bang was heard both by the crew members and by ATC. The aircraft then tilted to the right and yawed slightly. Suspecting a tyre failure the commander instructed the other Captain to abandon the take off, which he did as the speed reached approximately 135 kt to 140 kt. The pilot had no difficulty in keeping the aircraft straight and, as there was considered to be adequate runway length remaining, the autobrake system was cancelled at about 100 kt. During this time the commander advised the tower of the RTO and was instructed to remain on the runway until the fire service had carried out its inspection. The aircraft was brought to a standstill on the centreline of the runway just beyond the displaced threshold of Runway 09L with approximately 300 metres of runway remaining.

There was no fire and the passengers were able to remain on board the aircraft until airsteps arrived for their disembarkation.

Flight Data Recorder Information

The Flight Data Recorder, a Sundstrand DFDR, was removed and replayed by the AAIB; some of the data, including that covering the incident, was corrupted. The maximum airspeed recorded was about 140 kt. Of the 87 parameters recorded there was none which related to either the brake system or the tyres. The flight recorder was returned to the operator for investigation of the fault which caused corruption of some of the data.

Engineering examination

AAIB Inspectors were able to examine the damage to the aircraft while it was still in its position at the end of Runway 27R. The principal damage was to the tyres and wheels at the Nos 7 and 8 position: on the DC-10 type the wheels are numbered from left to right across the front and then the rear of the two main landing gears; thus wheels 7 and 8 are, respectively, the inboard and outboard rear wheels of the right-hand main landing gear, with wheels 3 and 4 immediately ahead. On both wheel Nos 7 and 8 only the tyre beads were still attached to the wheels and there was considerable damage to the wheel rims. On wheel No 8 there was a pattern of even wear damage around the circumference of the rim where it had worn while rolling along the runway. In contrast, the rim of wheel No 7 was fragmented with numerous and distinct fracture surfaces. On both wheels, a small area had worn flat where each rim had suffered rapid abrasion as the locked wheel had briefly skidded across the runway surface.

Witness marks around the wing and fuselage showed where a number of fragments had struck the airframe. Most of the impacts were from pieces of tyre striking the landing gear doors and the undersurfaces of the wing and inboard flap and aileron; the damage furthest forward was to the

translating cowl of the No 3 engine. There had also been damage from a substantial rim fragment of wheel No 7 passing through both surfaces of the inboard flap.

Although the fragments of tyre and wheel rim had been removed from the runway soon after the accident, the airfield operator (HAL) had prepared a diagram showing where the items of wheel rim had been found. This diagram showed a regular distribution along the runway of the fractured pieces of rim from wheel No 7, consistent with the scoring of the runway surface and indicating that the fragmentation of this wheel rim had not been the cause of the tyre failure but as a consequence of it. The same diagram showed the main carcasses of the tyres Nos 7 and 8 as a single cross, reportedly within some 20 metres of each other, consistent with very rapid failure of the second tyre after the failure of the first. No obvious FOD items (apart from the wheel and tyre debris) were identified, which is not unusual for this type of incident.

The fracture surfaces of the wheels themselves were examined at AAIB and in greater detail by the wheel manufacturer in the United States. These examinations confirmed that the rim failures were as a result of the tyre failures and the manufacturer reported that "both wheel assemblies exhibited damage that is produced by rolling on the bare rim. All of the fractures exhibited ductile, tensile fracture. No evidence of fatigue was found.". The difference in damage between the two wheels, where the rims of No 7 had fragmented and the rims of No 8 had worn evenly, was consistent with difference in design: the No 7 wheel was manufactured in the 1970s, before the "roll-on-rim" design was introduced, whereas it appears that the No 8 wheel was of later manufacture, with improved "roll-on-rim" capability. Unfortunately the detail part numbers of the No 8 wheel had been worn away during its roll along the runway.

The tyres from wheels Nos 7 and 8 were examined at the AAIB and then at the tyre manufacturer's retread facility in the Netherlands. The difference in pattern used in the interior bladder liners allowed the major items of tyre debris to be sorted and then reconstructed. On either tyre the detail examination revealed none of the signs which are characteristic of abuse, of re-treading problems or of manufacturing defects. On tyre No 8 there was a local fracture pattern indicating some form of foreign object damage to the tread and then to the carcass cords; there was no similar pattern in tyre No 7, indicating that this tyre had failed due to sudden additional load when an adjacent tyre (No 8) failed.

This sequence of failure, where the No 8 tyre failed due to foreign-object damage and tyre No 7 then failed due to sudden additional load, appears the most likely explanation of the initial event. It is also consistent with the distribution of the tyre fragments at the site and the pattern of tyre and wheel marks along the runway.

Previous examples

In this instance the aircraft was brought to a stop safely within the confines of the runway. Damage from the tyre and rim failures, whilst significant, did not seriously hazard the aircraft. For comparison study was made of the accident reports of two previous occurrences involving; the accidents to Continental Airlines DC-10-10, N68045, at Los Angeles on 1 March 1978 (NTSB-AAR-79-1) and to Pan Am DC-10, N 83 NA, at London Heathrow on 16 September 1980 (AIB AAR 2/82). Both earlier accidents were more serious in that fires started and passenger injuries occurred during the emergency evacuations. A distinctive common factor between the three occurrences was that the failure of one tyre resulted in the rapid failure of its 'mate' tyre on the same axle; the main difference was that the more serious 1978 and 1980 occurrences were at speeds close

to V_1 (peak recorded airspeeds of 159 kt and 171 kt respectively) whereas this occurrence, to PP-VMD, was at a lower speed, some 30 kt below V_1 .