Boeing 737-436, G-DOCL

AAIB Bulletin No: 10/2003	Ref: EW/C2003/06/06	Category: 1.1
Aircraft Type and Registration:	Boeing 737-436, G-DOCL	
No & Type of Engines:	2 CFM56-3C1 turbofan engines	
Year of Manufacture:	1992	
Date & Time (UTC):	15 June 2003 at 1045 hrs	
Location:	London Gatwick Airport, West Sussex	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 117
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Main landing gear tyre destroyed, significant damage to the right main landing gear fly door, superficial damage to the right flap and wing trailing edge area	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	27 years	
Commander's Flying Experience:	3,999 hours (of which 275 were on type)	
	Last 90 days - 160 hours	
	Last 28 days - 42 hours	
Information Source:	AAIB Field Investigation	

History of the flight

Following a normal takeoff from London Gatwick Airport the flight crew received notification from the operator that debris had been found on the runway. All indications on the flight deck were normal and the cabin crew reported that there had been no abnormal noises during the takeoff and initial climbout. However, a further message from the operator advised that the debris had been positively identified as having come from G-DOCL and they requested that the aircraft return to Gatwick. At this point the aircraft was under Brest Control but control of the flight was transferred back to London when the aircraft was on a northbound heading. At this point the flight crew declared a PAN due to the fact that the aircraft was above the maximum landing weight. The aircraft entered a holding pattern at FL240 to burn off fuel. The flight crew consulted the Brake Cooling Schedule in the QRH (Quick Reference Handbook) and decided to reduce the aircraft's weight to below 53,000 kg. This was to provide a balance between minimising braking energy whilst retaining sufficient fuel to provide further time in a holding pattern should problems occur extending the landing gear or flaps. A normal flap 40 landing was carried out using manual speedbrake, maximum reverse thrust and

minimal pedal braking. The aircraft vacated the runway with the airport fire services in attendance. There was no smoke or fire generated from the aircraft.

The airport operator recovered numerous pieces of tyre tread and the right main landing gear fly door from the runway.

Examination of the aircraft

The aircraft operator inspected the aircraft and found that the outboard right main landing gear tyre, from which the tread had separated, had remained inflated but did not measure its inflation pressure. The operator also found minor damage to the aircraft's right wing trailing edge and flap. A few days after the accident the operator measured the inflation pressure of the inboard right main landing gear tyre, the companion to the tyre that lost it's tread, and found it to be within normal operating limits.

Tyre history

The tyre that lost it's tread was manufactured in 1998. At the time of the accident the tyre had undergone five retread processes all of which had been carried out by the tyre's manufacturer. Between the date of manufacture and the accident, the tyre had been fitted to five different aircraft operated by the same airline. In each case the reason for the removal of the tyre from these aircraft was that it had worn to its tread limits. When it was removed at the end of its third retread (R3) a deep cut was noted. Inspection at the retread facility established that the deep cut had not damaged the tyre's carcass and it was accepted for a fourth retread process (R4). Following the fifth retread process (R5) a shearographic examination of the tyre was carried out. (Shearography compares a video image with a vacuum laser image of surface displacement characteristics which reveals flaws within materials by looking for strain anomalies on the surface.) This examination revealed two minor aberrations within the tread area that were assessed as acceptable and the tyre was approved as satisfactory for release to service. At the time of the accident the tyre was very close to the tread wear limit and had carried out 297 landings since the last retread (R5). The carcass had achieved 3,114 landings since manufacture.

Engineering examination

Both right main landing gear wheels together with their tyres were removed from the aircraft and taken to a wheel and brake overhaul facility where they were both inflated to their normal operating pressure and immersed in a water tank to check for leaks. No leaks were found from either of the wheels or tyres. The tyres were removed from their wheel rims and inspected for obvious signs of internal damage or stress; none was observed. The tyres, together with the pieces of tread recovered from the runway were taken to the tyre manufacture's retread facility for further examination.

The detailed examination showed that the tyre's tread had separated from the carcass at the original manufactured carcass to tread interface layer for the full circumference of the carcass and from shoulder to shoulder. During the examination of the recovered tread pieces it was found that the retread performed at R5 had remained fully intact and that all the tearing and separation was below the retread area. There was no evidence of unsatisfactory adhesion at the retread interface with the original manufactured tyre. Examination of the carcass revealed an area extending approximately half the width of the tread and for a distance of about 25 cm around the circumference where the separation varied, exhibiting tearing within and between the original manufactured tyre and the re-treaded new sub-tread material. This area was identified as the site of the initial tread separation. Examination of the tread pieces and exposed carcass plies did not reveal any evidence of cut damage or significant under-inflation; however, severe heat damage was evident to both the tread and carcass with localised extensive heat discoloration (bluing) extending around the complete circumference of the tread. Re-construction of the tread pieces onto the carcass showed that approximately 95% of the tread had been recovered from the runway. Unfortunately, it was found that the section of tread in the area of the initial separation had not been recovered.

Examination of the shearograph images made following the fifth retread process (R5) showed that one of the aberrations was located in the middle of the area where the initial separation of the tread

occurred. Following the accident, the carcass was re-inspected using shearography and the aberration in the area of the initial tread separation was no longer evident indicating that it had been within the original sub-tread to top casing ply interface. The inner liner of the tyre was subjected to an air needle injection test. This test injected air at 100 psi into the carcass plies and a leak detection solution was sprayed onto the outer carcass layer. No air leaks in the liner were detected.

Conclusions

From the evidence available it was not possible to establish fully the cause of the tread separation. There was sufficient evidence to conclude that the tread separation may have been attributed to either of the following:

The tyre had developed, during the R5 retread life, a small area of looseness and associated tread separation originating from a manufacturing flaw within the original sub-tread to casing interface.

Or

Progressive internal heat build-up, over the whole life of the tyre, induced by extreme operational conditions resulted in degradation and a localised breakdown of component adhesion strength within an area of the brake-side shoulder region of the tyre. The airline concerned, which operates a large fleet of aircraft that use this size and type of tyre, had not experienced this form of failure within the previous 15 years.