

INCIDENT

Aircraft Type and Registration: Boeing 747-238B, G-VJFK

No & Type of Engines: 4 Pratt & Whitney JT9D-7J turbofan engines

Year of Manufacture: 1974

Date & Time (UTC): 5 November 1993 at 1307 hrs

Location: London Heathrow Airport

Type of Flight: Maintenance Ferry Flight

Persons on Board: Crew - 5 Passengers - 3

Injuries: Crew - None Passengers - None

Nature of Damage: 8 burst tyres, damage to left wing gear strut fixed door, body fairings and electrical conduits

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 58 years

Commander's Flying Experience: 18,500 hours (of which 5,300 were on type)
Last 90 days - 164 hours
Last 28 days - 51 hours

Information Source: Aircraft Accident Report Form submitted by the pilot and report on technical investigation by the operator

The aircraft was on a return flight from Dublin following scheduled maintenance and touched down from a stabilised ILS approach on Runway 09L at 133 kt. The wind was from 070° at 5 kt and the runway surface was dry. The aircraft was light at 195T and this condition was below the range of the graph available for the calculation of the approach reference speed however, with flaps selected to 25°, the approach reference speed had been calculated as 130 kt. 'MINIMUM' autobrake had been selected with anti-skid protection 'ON'. The touchdown was felt to be smooth but almost immediately, as the auto-spoilers deployed, the nose pitched down sharply and deceleration increased to something equivalent to or in excess of 'MAXIMUM' autobrake, followed by a loud bang and severe vibration. Autobraking was switched 'OFF' but the vibration continued as the aircraft decelerated. The tower advised the crew that they had multiple tyre bursts and advised them to stop on the runway but as the aircraft was approaching a turnoff the crew took the exit and brought the aircraft to a halt. Following an initial inspection the aircraft was towed to a stand accompanied by fire vehicles.

Both outer tyres on both wing bogies (Nos 1 and 3 and 14 and 16) and both inner tyres on the two fuselage bogies (6 and 8, 9 and 11) had burst. The group containing wheels 1,3,9 and 11 and the group with 6, 8, 14 and 16 were each a 'locked wheel group' in the anti-skid system. Examination of the failed tyres by the manufacturer showed that they had each burst from a single heavy scuff but had rotated after rupture. When the wheel temperatures were examined after the incident the wheels with the burst tyres were found to be cool and the others warm.

An examination of the maintenance work pack which had just been completed revealed that no areas of the braking system had been worked on and no other maintenance or technical faults of significance were identified. Functional checks were carried out on the landing gear sensing system, the touchdown protection system, the anti-skid system (200 tooth version) and the parking brake system and no discrepancies were found other than those described below.

The No 11 wheel anti-skid function was found to be defective and the corresponding anti-skid module in the right fuselage wheel well was removed for strip examination. The control valve for the No 11 wheel was found to be faulty. Though several other defects were found in the module, none could be related to the tyre failures on the other wheels. The autobrake controller was subjected to a functional test and an internal, visual inspection and no fault was found. When it was heated under controlled conditions and retested a temporary fault developed in which it cycled between the armed and disarmed conditions, the indicator light glowing dimly as it did so. The indicator bulb was replaced and the problem disappeared and could not be reproduced. Such a defect in the autobrake controller should not have affected the anti-skid function though it could have resulted in a malfunction of the autobraking system.

In 1986 and 1987, following incidents of multiple tyre scuffing or deflation reported by two operators Boeing issued 'In Service Activity Reports' (Nos 86-4 and 87-26). Report 87-26 stated:

'...it is considered possible that the multiple tire (sic) damage/bursts may have been caused by a temporary deactivation of touchdown protection due to the airplane becoming airborne for a brief period following initial touchdown (ie a light touchdown and small bounce at a shallow approach angle).

It is possible that if a shallow angle approach landing is made with brakes manually applied prior to touchdown the following sequence of events may occur.

The airplane initially touches down briefly thereby removing the truck out of tilt and initiating decay of the touchdown protection brake release signal. However, ground contact is not firm enough to cause all the wheels to spin up. The airplane then leaves the ground briefly (without the trucks rettiling). This allows manual brake application

to lock the brakes when the touchdown protection brake release signal decays (after approximately 2 seconds decay time). Consequently, when the airplane touches down the second time the wheels are locked. Although this sequence of events has occurred in the past, the likelihood of wheel lock-up due to insufficient spin-up is considered low.

Use of autobraking should preclude wheel lock-up during landing....

Master Change MC43237...adds a time delay...to allow more time for wheel spin-up..'

The operator pointed out that in the case of G-VJFK the pattern of tyre bursts appeared to be related to the wheel contact sequence as observed, for instance, when the aircraft is lowered symmetrically from jacks. The tyres which make first contact had not burst, raising the possibility that, if the landing had been particularly light, the bogies could have moved out of tilt (initiating decay of touchdown protection) and these wheels could have spun up but that touchdown protection may have decayed fully before effective ground contact was made on the other tyres. If this hypothesis is correct then the fact that the damaged wheels comprised two complete 'locked wheel groups' means that the protection against wheel locking provided by the 'locked wheel group' system would not be available as no wheel within either group would have spun up to give a speed reference within the group.

Autobraking would not have started becoming effective until the average speed of the eight reference wheels attained 80 kt but as four of these had suffered tyrebursts and probably, therefore, did not spin up initially then it would appear probable that autobraking was not in operation at the time of the incident.

The normal 'G' trace on the FDR was not working and so a direct indication of the nature of the touchdown was not available but an examination of other FDR data found no indication that the touchdown would have been particularly light; a positive approach towards the ground was maintained in the latter stages and the flare appeared normal.

Boeing plan to revise the 747-400 Training Manual at the next normal revision date to include recommendations for landing very light aircraft but there are no plans to revise training manuals for out-of-production 747 models.