

No: 12/89

Ref: EW/C1134

Category: 1a

**Aircraft Type
and Registration:**

Boeing 747-136, G-AWNB

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

Year of Manufacture: 1970

Date and Time (UTC): 5 September 1989 at 1152 hrs

Location: London Gatwick Airport

Type of Flight: Public Transport

Persons on Board: Crew - 18 Passengers - 318

Injuries: Crew - None Passengers - None

Nature of Damage: Severe damage to intake cowling and LP compressor of No 3 engine.
Superficial damage to inboard wing flap fairing

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 43 years

**Commander's Total
Flying Experience:** 10,949 hours (of which 8,116 were on type)

Information Source: AAIB Field Investigation

The 1100 hrs scheduled departure of the flight from Gatwick to New York was delayed for about 50 minutes whilst awaiting a take-off "slot time" from ATC. When clearance was received, the engine start, taxiing and the selection of take-off power were uneventful and the take-off roll began at 1151 hrs on runway 26 L.

The Maximum Authorised Take-off Weight of the aircraft was 332,900 Kg and the actual weight was 318,499 Kg, which provided a V_1 of 142 kt. During the take-off roll, at a speed recorded as 104 kt, there was a loud bang, vibration was felt and the aircraft started to pull to the right. At the same time, the No 3 engine EGT rose rapidly through 915° C to 950° C, the flight engineer called "engine failure" and the commander, who was the handling pilot, called "stop". The appropriate drills were executed and as the aircraft slowed, the commander elected to use the high speed turn-off, designated "2RET", in order to point into wind. During the deceleration the co-pilot informed ATC of the rejected take-off and during the drills the commander made contact with the Airport Fire Service (AFS) on 121.6 MHz.

ATC immediately declared an "Aircraft Accident" and the AFS very quickly responded, arriving at the aircraft as it came to a halt on the high speed turn-off. On request, the AFS informed the commander

that the landing gear, bogies and wheels were undamaged but that No 3 engine was damaged, though there was no fire. ATC immediately closed the runway and requested that the AFS assist with the retrieval of debris which included the entire tail-cone of the No 3 engine.

The crew then waited for the brake temperatures to stabilise before taxiing, escorted by AFS vehicles, to parking stand 152. The passengers disembarked and were returned to the terminal.

Inspection of the No 3 engine showed that a fan blade had failed close to the blade root and was missing from the engine. It was later recovered in several pieces from the side of the runway, having apparently moved forward after separation, exiting the engine and holding the intake cowling at about the 1 o'clock position (viewed from the front). It was also apparent that there was severe damage to the initial stages of the LP compressor behind the fan, with many stators missing or dislodged. The second stage (LP2) compressor disc appeared to have separated into several segments.

More detailed examination suggested that the fan blade failure was due to secondary damage caused by debris from the LP2 stage moving forward and impacting the fan, since there were no indications of any pre-existing defect on the blade fracture surfaces. A piece of the LP2 compressor disc recovered from the vicinity of the runway did, however, show clear evidence of fatigue on one of its fracture surfaces.

Although damage to the airframe was of a very superficial nature, with only minor debris impacts found on an inboard flap fairing, it was noted that approximately 50 percent of the bolts securing the intake cowling to the engine had either failed or come undone, apparently due to severe vibration. This same vibration had also resulted in separation of the engine tail cone.

The engine was removed and strip-inspected whilst the pieces of LP2 compressor disc were subjected to metallurgical examination at the Manufacturer's premises. This examination has concluded that the primary failure lay in the LP2 compressor disc which developed a fatigue crack in the area of the tangs which attached the air seal. Unfortunately the pieces of LP2 disc recovered did not contain the fatigue origin and, despite an* extensive search, the missing section was not recovered.

Although it has therefore proved impossible to determine the precise reason for the fatigue development, British Airways and Pratt and Whitney embarked on a 100 percent inspection programme of all JT-9D LP2 compressor discs in the British Airways, fleet using a specially developed eddy current technique which allows on-wing accomplishment. At the time of writing, some 40 engines have been inspected with no indications of cracks observed. The failed disc had flown about 11,600 cycles of its 15,000-cycle life. The manufacturer has stated that this is the first report of any problems with the LP2 disc on the JT9D engine.