No: 4/83 Ref: EW/C814/01

Aircraft:	Boeing 707-329C N3238S (multi-jet public transport aircraft)
Year of Manufacture:	
Date and time (GMT):	1 March 1983 at 1241 hrs
Location:	London/Gatwick Airport
Type of flight:	International charter
Persons on board:	Crew - 10 Passengers - 175
Injuries:	Crew - Nil Passengers - Nil
Nature of damage:	Substantial damage to No 2 engine upper outboard cowling, and minor skin damage to underside and leading edge of left wing. Ingestion of debris by No 1 engine
Commander's Licence:	Air Transport Rating (United States of America)
Commander's Age:	
Commander's total flying experience:	About 19,500 hours (of which about 2,500 hours were on type)

The aircraft was on an international charter flight from London/Gatwick Airport to Miami International Airport, with a crew of 10 and 175 passengers on board. After a normal start up and taxy sequence, the aircraft was cleared for take-off from runway 26 at Gatwick Airport at 1239 hrs. The aircraft commander was the handling pilot. The take-off run was normal until the rotation speed of 154 knots, when the aircraft was felt to yaw slightly to the left. Shortly afterwards the flight engineer reported that the No 2 engine EPR (engine pressure ratio) indication was falling and that the EGT (exhaust gas temperature) was rising. The engine was progressively throttled to keep the EGT within limits. Company procedures require that, on take-off, emergency drills, unless vitally necessary, are not carried out until the aircraft has climbed to 800 feet above ground level. When this height was achieved, the commander ordered the flight engineer to check the No 2 engine indications. The flight engineer reported that the only abnormalities were a slightly higher than normal oil temperature indication and that the No 2 engine vibration meter was indicating off-scale high. The commander immediately ordered the shut down of No 2 engine, informed London Airways Air Traffic Control of the situation, and requested clearance to an area where the aircraft could jettison fuel before landing back at Gatwick Airport. Fuel was jettisoned and the aircraft landed back at Gatwick Airport, without further incident, at 1337 hrs.

An investigation was started the same afternoon, and the aircraft's Cockpit Voice Recorder (CVR) and Flight Data Recorder (FDR) were removed

and taken to the AIB facility at Farnborough for read-out. The CVR was found to have been erased, as the aircraft had been shut down according to the normal check list procedure. The FDR read-out was of good quality but the information recorded was limited and did not include a measure of engine performance (EPR). Thus the read-out merely confirmed the yaw that occurred on rotation, but did not record the loss of engine power. The aircraft's weight and balance were within the prescribed limits, and the calculated take-off speeds were correct for the aircraft weight and surface weather conditions. The aircraft's technical log indicated that it had been properly maintained and that there were no outstanding technical defects.

Detailed examination of the No 2 engine revealed that the diffuser case had ruptured and HP (high pressure) air had been released into the engine cowl. The resulting cowl over-pressure could not be controlled by the blow-out doors and the upper half of the engine access cowl had been torn away, and became wrapped around the leading edge of the left wing, outboard of the No 2 engine pylon and wedged in the wing leading edge high lift device. Some pieces of the debris from the damaged cowl were thrown outboard and entered the No 1 engine intake, causing significant damage to the fan assembly before being ejected via the bypass duct. Fortunately this damage was symmetrically disposed, and the No 1 engine continued to run normally and produce maximum power. The separated section of the engine cowl remained lodged on the left wing leading edge throughout the flight, and was removed after the aircraft had landed.

Microscopic examination of the failed portion of the diffuser case revealed that the rupture had initiated at pre-existing fatigue fractures at the weld between the outer diffuser case and the outboard side of the top diffuser case strut. This had resulted in a strip of diffuser casing, approximately 15 cm square, peeling back and allowing HP air into the engine cowl. The fatigue cracks had evidently been present for some considerable time, and as a consequence most of the microscopic detail had been lost as a result of corrosion and bruising. The failed area was bifurcated near the forward end of the weld. An upper branch of the crack had affected the weld at the strut cover pad, and a lower crack had affected the weld between the strut itself and the outer case. This lower fatigue crack also extended approximately 1.5 cm into the diffuser case proper, at the rear end of the weld, and approximately 1.25 cm into the diffuser case at the forward end of the weld. A pre-existing rupture type fracture was also found to extend forward of the fatigue cracks by a further 7.25 cm, making a total pre-existing fracture length of approximately 17 cm.

The cracking of the diffuser case of this type of engine is not a new problem, and repair and monitoring schemes are in existence. The CAA, FAA, and engine manufacturer have been informed of this incident, and it is understood that remedial action is under consideration.