

**Aircraft type and registration:** Boeing 757—200 G-BIKA (twin jet public transport aircraft)

**Year of Manufacture:** 1982

**Date and time (GMT):** 2 April 1985 at 1432 hrs

**Location:** Overhead Woking, Surrey

**Type of flight:** Scheduled Public Transport

**Persons on board:** Crew — 8                      Passengers — 119

**Injuries:** Crew — Nil                      Passengers — Nil

**Nature of damage:** Severe damage to No 1 engine, and cowl holed

**Commander's Licence:** ATPL

**Commander's Age:** 52 years

**Commander's Total Flying Experience:** 9868 hr (of which 778 hrs were on type)

**Information Source:** AIB observation of investigation and report by engine manufacturer.

The aircraft took off from Runway 28R at London Heathrow and commenced a climb to the south for Milan. Both the take-off and climb were made using de-rated engine power settings appropriate to the aircraft all-up weight, and no abnormalities were noted. At around 8700 feet there was a bang immediately followed by indication of excessive No 1 engine Exhaust Gas Temperature (EGT). There was no engine fire warning. The engine was shut down and the aircraft returned to Heathrow without further incident.

The engine, a Rolls Royce RB 211-535C-37 turbofan, was rated at 37400 lb take-off thrust. Examination revealed that the Stage 1 Disc of the High Pressure Compressor (HPC) had separated into two pieces, had detached from the remainder of the compressor, and had penetrated the HPC casing. The larger portion of disc, around two thirds of the total, remained lodged in the fan duct surrounding the HPC casing, while the smaller portion penetrated the fan casing and cowl and departed the aircraft. It was subsequently handed in from near Woking, Surrey by a member of the public. The separated disc pieces damaged a number of pneumatic pipes and electrical cables on the engine and in the engine pylon. Debris passing back through the engine caused extensive blade damage to the remainder of the HPC.

The disc, which constituted a wheel rim of 23 inches outside diameter and 13 inches inside diameter, was of titanium IMI 685, produced in ingot form from its alloying constituents by a double melt process in an electric arc vacuum furnace. At the time of its failure the disc had reportedly accrued 3854 hours/3188 flight cycles since new.

Detailed investigation by the engine manufacturer indicated that the disc had failed in normal operation because of a large sub-surface radial crack in the bore section. This had originated within a large inclusion of sub-standard material exhibiting abnormally coarse grain structure and containing micropores, some of which contained sodium chloride. It was believed that

small cracks originating from a number of micropores had grown rapidly, possibly accelerated by the presence of sodium chloride, and coalesced to form a crack of sufficient size for propagation to commence in low cycle fatigue. The evidence indicated that the deteriorated material properties associated with the inclusion would have promoted more rapid fatigue growth than in the normal disc material.

Experimentation indicated that a sub-standard inclusion of the type found could result during material manufacture if a substantial portion of the ingot produced by the first melt process detached during the second melt and thus failed to melt a second time. Review of melt records for the ingot from which the failed disc originated revealed that an occurrence consistent with such an event did in fact occur. An extensive review aimed at ensuring that no other discs are similarly affected is in progress. Manufacturing procedures have changed since the material from which the failed disc originated was manufactured.