

No: 9/88

Ref: EW/C1058

Category: 1b

Aircraft Type and Registration: Beech C90 Kingair, G-BNAT

No & Type of Engines: 2 Pratt and Whitney Canada PT6A-20 series (propeller-turbine engines)

Year of Manufacture: 1973

Date and Time (UTC): 25 January 1988 at 2247 hrs

Location: East Midlands Airport

Type of Flight: Commercial (cargo)

Persons on Board: Crew -1 Passengers - None

Injuries: Crew -1 (Fatal) Passengers - N/A

Nature of Damage: Aircraft destroyed

Commander's Licence Senior Commercial Pilot's Licence

Commander's Age: 36 years

Commander's Total Flying Experience: 2900 hours (of which 600 were on type)

Information Source: AAIB Field Investigation

History of the flight

The aircraft left Southend with full fuel tanks, but with no payload. It landed at Stansted 10 minutes later, where it was loaded with 110 packages of mail weighing a total of 800 kg. This would have brought the aircraft up to a weight some 90 kg above its maximum authorised take-off weight. It then took-off for East Midlands Airport where, after allowing for the fuel used on route, it would have arrived at least 160 kg above its maximum authorised landing weight.

When the pilot first established radio contact, East Midlands ATC advised him that the wind was 060°/8 kts, visibility 2500 metres, with 1 okta of cloud at 100 feet and 8 oktas at 400 feet: surface temperature and dew point were both +5°C. Five minutes later, ATC advised that visibility had reduced to 1600 metres. Soon afterwards, some 13 minutes before the accident, ATC made a special broadcast to all inbound aircraft advising that visibility had reduced to 600 metres, but the runway visual range (RVR) was 1100 metres.

G-BNAT flew radar vectors for an ILS approach to runway 09, and established on the localiser at a range of 11 nm. One aircraft ahead was approaching the outer marker at about that time. It landed just after G-BNAT passed the outer marker. As G-BNAT was on approach 1 nm from touchdown, ATC advised that the RVR for landing had reduced to 900 metres and, very soon afterwards, notified a further deterioration to 800 metres. Immediately after this last ATC transmission, the pilot transmitted

"NATIONAL SIX FOUR SIX GOT TO GO-AROUND". Ten seconds later he transmitted "CRASHING.....NATIONAL". The aircraft subsequently struck the ground at a point approximately 350 metres to the right of the runway 09 centreline and 750 metres beyond the threshold.

Radar data showed that G-BNAT maintained both the localiser and the glideslope during the ILS approach, which was flown at an airspeed varying between 135 and 140 kts. At one mile from touchdown, the aircraft descended below the radar horizon at a height of approximately 325 feet above the ground and reappeared 33 seconds later at approximately 225 feet, to give one more radar return before the trace finally disappeared. The trace from a different radar head showed the same pattern except that the final return showed a height of 425 feet above the ground. The last returns showed that the aircraft was on the centreline and approximately over the runway threshold when it disappeared from radar and that, during the 33 seconds between the last two returns, it had maintained an average groundspeed of 125 kts.

Only two witnesses were found who had seen or heard the aircraft. One, who was located 400 metres to the right and 360 metres beyond the start of the runway reported that he heard aircraft engines at high power and saw the lights of an aircraft climbing unusually steeply. The lights were in sight for only a very short time before lost to sight behind the roof of an adjacent hangar. He then heard the aircraft crash and saw a bright orange ball of light from the other side of the hangar. The second witness was on the other side of the same hangar, which lay between him and the runway. He also heard aircraft engines, but described them as sounding like the noise of a twin-turboprop aircraft taxiing. He also heard the noise of the crash, but saw nothing.

Examination of the wreckage

Examination of the accident site showed that the aircraft had struck the ground in an approximately 45° dive, with wings level. The impact track was 114° magnetic, ie 24° to the right of the runway heading. Marks on the ground revealed that the landing gear was extended at impact. The aircraft was badly broken-up, with the furthest flung wreckage items being found approximately 100 metres from the impact point. The main wreckage was severely affected by the post-impact fire.

Following an on-site examination, the wreckage was removed to AAIB's facility at Farnborough for detailed examination.

It was established that the primary flying control operating cables were intact prior to impact, as were the flexible drive shafts between the electric flap motor and the flap screwjacks. The screwjack extensions corresponded to a flap deflection of approximately 14°, ie a typical approach selection. It was also established that the aircraft was structurally complete.

When the engines were examined, it was observed that a rubber/fabric diaphragm within the compressor bleed valve from the right hand engine had a small (approximately 0.1 inches) split present. The function of this valve (which is installed on the compressor casing) is to spill inter-stage compressor air at low engine speeds, thereby providing surge protection. The valve gradually closes as higher engine speeds are attained. A piston assembly is contained within the bore of the housing, and the rolling diaphragm allows full piston travel to open or close the port, at the same time effectively sealing the compartment at the top of the piston. The valve is normally closed at engine speeds in excess of 80% Ng (gas generator rpm) and the effect of the split would be to prevent this happening, with a consequent power loss and high inter-turbine temperature (ITT). The aircraft technical records showed that the bleed valve diaphragm had been renewed some 1400 hours before the accident, the overhaul period of the valves being 3500 hours.

In order to quantify the loss of power, the valve was subsequently fitted to the right engine of an intact aircraft and a ground test conducted using both engines. It was found that when the throttles were advanced together, the right engine torque lagged 200-300 ft lb behind the left engine's nominal 1250 ft lb indication. However, most of this loss could be recovered by moving the right throttle forward of its normal position. Eventually, the engine became Ng limited, but the ITT indication, although high, remained within limits. (Note: this engine type is torque-limited at 1325 ft lb, which is why the throttles normally may not be pushed fully forward when high power is required.)

The aircraft manufacturer conducted a series of computer simulations whereby an engine asymmetry, similar to that noted above, was applied to an aircraft executing a missed approach from a height of 50 feet agl, 100 kts IAS, with the landing gear down and the flaps at 15°. The aircraft was allowed to respond freely, ie with no corrective pilot inputs. The results showed that impact occurred 16 to 18 seconds later, 760 metres from the point of initiation, 450-500 metres to the right of centreline. The heading change was 150° and the bank angle at impact was 60°. Clearly there is no way of establishing what control inputs were made by the pilot of G-BNAT, although the impact parameters as derived from the ground marks indicated that the wings had been levelled. Furthermore, the steep angle of impact was suggestive of a dive following a stall.