No: 3/91 **Ref: EW/C91/1/2** **Category: 1b**

Aircraft Type and Registration:	Beech 200 Super King-Air, G-VPLC	
No & Type of Engines:	2 Pratt and Whitney PT6A-41 turboprop engines	
Year of Manufacture:	1980	
Date and Time (UTC):	14 January 1991 at 1616 hrs	
Location:	Milton, Derbyshire	
Type of Flight:	Private (Corporate)	
Persons on Board:	Crew - 1	Passengers - 2
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Left side main wheels detached, nose landing gear collapsed, damage to propellers, fuselage underside, left nacelle and flaps	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	43 years	
Commander's Total Flying Experience:	5,000 hours (of which 800 hours were on type)	
Information Source:	AAIB Field Investigation	

On 7 January 1991, G-VPLC was flown from its base at Barrow-in-Furness to Plymouth with an intermediate stop at Northolt. Prior to departure the wing and nacelle fuel tanks had been filled to capacity, a total of 2580 lb. The sector Barrow-in-Furness to Northolt had been flown at FL 230 with a flight time of 50 minutes and Northolt to Plymouth was flown at FL 70 with a flight time of 1 hour. The aircraft remained at Plymouth for one week, whilst work was carried out including an inspection for renewal of the aircraft's Certificate of Airworthiness. The work included ground running of both engines. The aircraft was not re-fuelled at Plymouth.

History of the Flight

On 14 January 1991 the pilot and one passenger were flown to Plymouth in order to fly the accident aircraft back to Barrow-in-Furness, via Northolt where a further passenger was to be picked up. The fuel contents on departure from Plymouth were reported to be 1420 lb, with the left fuel gauge indicating 720 lb and the right gauge indicating 700 lb. The aircraft departed Plymouth at 1431 hrs, cruised at FL 50, and landed at Northolt at 1524 hrs. On arrival the pilot reports that he considered that there was 1000 lb (500 lb per side) of fuel remaining.

The engines were restarted at 1535 hrs and the aircraft took off at 1542 hrs having been cleared for a Standard Instrument Departure (SID) to "Park". London ATC provided radar vectors and an unrestricted climb to the cruising level, FL 240. The pilot reported FL 240 at 1555 hrs, and states that when carrying out the cruise checks he was surprised to see the fuel gauges indicating 120 lb LEFT, and 100 lb RIGHT. At 1606 hrs he informed London ATC "WE HAVE A FUEL PROBLEM AND WE'D LIKE TO DIVERT TO THE NEAREST AVAILABLE AIRFIELD NOW". He did not declare an emergency or report low fuel contents. London ATC informed him that his position was 5 nm from East Midlands Airport and cleared him for immediate descent. At 1609 hrs control was transferred to Manchester ATC who further transferred control to Castledon (East Midlands) Approach at 1611 hrs. The pilot did not declare an emergency to either of these agencies or advise them of low fuel contents.

When the pilot first contacted Castledon Approach, the aircraft was descending through FL 100 and was approximately 10 nm from the runway 09 threshold. He was offered radar vectors to the runway 09 ILS and informed that he was number two in traffic. The pilot acknowledged this information and requested an expeditious recovery. As the aircraft turned onto the ILS centre line at a range of 8 nm from touch down, the pilot noticed fluctuating fuel flow and torque on the right hand engine gauges. The right fuel gauge was reading zero, the left gauge was fluctuating between 50 lb and 100 lb and so he opened the cross-feed cock. Realising that he was not going to reach the runway he decided to make a powered approach and forced landing. At 1616 hrs he declared an emergency stating "WE ARE OUT OF FUEL". His selection of a suitable field for landing was restricted by the proximity of electricity cables and some buildings. He informed his passengers of the imminent forced landing and advised them to sit in the rearward facing seats, which they did. As the aircraft was flared for landing he closed the fuel supply and feathered the propellers. All occupants vacated the aircraft without injury.

Examination of the Aircraft

The aircraft had touched down in a ploughed field which, although fairly rough and undulating, was frozen and firm. Initial contact had been light on the main landing gear, followed by the nose landing gear which had then been lifted again as the aircraft approached a substantial boundary hedge 57 metres from the touch down point. The mainwheel tracks continued right up to the hedge and all three landing gears passed through it. The left landing gear struck some thick stems causing the axle assembly to detach from the bottom of the ram. The right and nose landing gears remained intact until the stub of the left gear dug into the ground and the aircraft started to yaw to the left. The nose landing gear then collapsed and the aircraft came to rest on a heading of 275°(M), after an initial touch down heading of 345°(M) and after a total ground run of 91 metres.

Apart from the broken left landing gear, there was damage and distortion in the area of the left nacelle and firewall and to the flap assemblies. The impact of the nose landing gear, in addition to folding it backwards, had pulled the oleo assembly from its housing with the result that the wheel had been pushed up into the fuselage aft of the wheel bay thereby crushing the pressure bulkhead.

Both propellers were in the static, feathered position and all blades had varying degrees of bending and deformation. It was apparent that they were both rotating at impact with the hedge but were not under power.

When electrical power was re-applied to the aircraft it was noted that both fuel gauges indicated zero. A physical inspection of the contents of the wing fuel tanks revealed less than one litre in each. The nacelle, which also functioned as collector tanks and therefore represented the fuel immediately available to each engine, had approximately two litres in each side (see photograph). The auxiliary tanks were also confirmed empty by visual inspection. There were no signs of leakage anywhere in the fuel system.

The aircraft was maintained on a Private Category Certificate of Airworthiness to a Beechcraft recommended schedule. Such operation did not require the recording of fuel uplift or consumption figures in technical documents, nor was there any requirement for a routine calibration of the fuel gauging system. Fuel quantity was monitored by a capacitance fuel gauging system. The Aircraft Flight Manual stated that "a maximum 3% error may be encountered in this system". The engine ground running during the inspection at Plymouth had, however, included a check on engine performance parameters and these were found to be well within the manufacturer's limits. The supervisor in charge of the work also recalled that, whilst performing no formal checks on the fuel gauging system, he had noticed no signs of anomalies or discrepancies to suggest that the system was not indicating correctly.

Fuel consumption

When G-VPLC departed Barrow-in-Furness on 7 January 1991 it is reported that the wing and nacelle fuel tanks were full and the auxiliary tanks were empty. Thus a total of 2580 lb should have been carried. The operator did not use in-flight fuel logs nor were fuel quantities on landing recorded. A calculation of fuel consumption from the departure from Barrow-in-Furness until the precautionary landing at Milton was prepared, using typical figures derived from the manufacturer's Aircraft Flight Manual. It was assumed that the recommended technique for long range cruise was used on all flights.

The flight time from Barrow-in Furness to Northolt was recorded as 50 minutes at a cruising level of FL 230. The flight time from Northolt to Plymouth was recorded as 1 hour at a cruising level of FL 70. A calculation showed that, using optimum consumption and with minimum ground taxiing time, the aircraft could not have landed at Plymouth with more than 1600 lb of fuel (800 lb per side). The engineer who carried out the ground running at Plymouth estimates that about 100 lb of fuel per engine would have been consumed, and he recalled fuel gauge indications in the region of 1400 lb (700 lb per side). The pilot also had a similar recollection of 720 lb LEFT, and 700 lb RIGHT indicating on the gauges.

The flight time from Plymouth to Northolt was, according to entries in ATC arrival and departure logs, 53 minutes at a cruising level of FL 50. After landing at Northolt the pilot stated that he considered that the fuel gauges were indicating about 1000 lb (500 lb per side). The fuel consumed during the flight

from Plymouth to Northolt, which must have been flown at a relatively high airspeed, was calculated to have been at least 700 lb, suggesting that the indicated contents that the pilot recalled were in fact closer to 700 lb (350 lb per side).

After take-off from Northolt the aircraft made a continuous climb to the cruising level of FL 240. After 11 minutes of cruising flight the pilot noticed the fuel contents indicating 120 lb LEFT, and 100 lb RIGHT when he decided to request a diversion to the nearest airfield. Ten minutes later he realised that the aircraft had run out of fuel and made the precautionary landing. For this sequence to have occurred, the total fuel contents on take off from Northolt must have been about 600 lb. In the absence of accurate fuel consumption records and subject to minor variations, it has been established that the aircraft ran out of fuel at a time that was close to a predicted time calculated from the manufacturer's performance data.