Aviation Safety Investigation Report 199402892

Beech Aircraft Corp Baron

07 October 1994

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NOTE: All air safety occurrences reported to the ATSB are categorised and recorded. For a detailed explanation on Category definitions please refer to the ATSB website at www.atsb.gov.au.

The Bureau did not conduct an on scene investigation of this occurrence. The information presented below was obtained from information supplied to the Bureau.

8km ESE Port Hedland		
N		
4	Inv Category:	4
day 07 October 1994		
17 hours	Time Zone	WST
ne		
Beech Aircraft Corp 58 VH-EPJ Charter Passenger Nil Felfer WA 527 WST Port Hedland WA	Serial Number: TH	I-858
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Crew Details:

	Hours on			
Role	Class of Licence	Туре Но	ours Total	
Pilot-In-Command	Commercial	100.0	990	

Approved for Release: Tuesday, December 19, 1995

HISTORY OF THE FLIGHT

VH-EPJ was engaged in an instrument flight rules charter flight, with two passengers, from Telfer to Port Hedland. The flight had departed Port Hedland at 0650 that morning, arriving at Telfer at 0759. The aircraft remained at Telfer until 1526 after which, it departed for Port Hedland.

At a position 138 km south-east of Port Hedland, whilst cruising at 6,000 ft, the pilot observed that the left fuel quantity gauge was indicating empty. He selected the left fuel selector to 'crossfeed' and turned on the left fuel boost pump. After checking his fuel calculations, the pilot elected to continue the flight to Port Hedland. Within two minutes the left engine began surging. This was followed by surging in the right engine. The pilot completed the basic engine failure drills; however, due to his concern over control difficulties resulting from the yawing caused by the surges, he elected to shut down both engines, feather the propellers, and conduct an emergency landing. The aircraft landed without further incident on the Port Hedland to Marble Bar road.

After obtaining fuel for the aircraft the pilot flew it to Port Hedland.

PERSONNEL INFORMATION

The pilot of VH-EPJ, at the time of the occurrence, was also the Chief Pilot (CP) of the operating company. The CP was the only pilot to operate VH-EPJ after 29 June 1994. The pilot had completed his Beechcraft Baron endorsement in a BE55 which has a different fuel tank configuration to the BE58. During this endorsement the determination of fuel contents using the filling point tabs was discussed. Because the fuel tank arrangement in Baron aircraft does not lend itself to easy determination of the fuel contents, other than through the gauging system, it was recommended to the pilot that he always keep an accurate manual fuel log when operating the aircraft. Although the presence of wing mounted fuel gauges, in the BE58 was mentioned, the specifics of fuel management in the BE58 were not covered. This was left for the pilot to pursue. An endorsement in a BE55 qualifies a pilot to act as pilot-in-command of a BE58.

AIRCRAFT INFORMATION

VH-EPJ is fitted with rubber bladder type wing fuel tanks. An inspection of these tanks indicated that they had not collapsed at the time of the occurrence. The aircraft owner advised that the fuel gauging system had been calibrated twelve months prior to the occurrence and that the average normal fuel consumption for VH-EPJ was 113-115 L/hour.

Wing-mounted fuel quantity gauges provided the potential to indicate fuel quantities between 40 and 60 US gallons (151 L - 227 L) in each wing tank. The fuel tanks were fitted with tabs which had the potential to give a fuel indication of approximately 302 L in each tank.

The aircraft was not fitted with a placard or decal which indicated, to a pilot, what the tab indication meant. Nor was the information included in either the aircraft flight manual or company operations manual. The left and right exhaust gas temperature gauges (EGT), used to assist in accurately leaning the engine fuel mixture in flight, were unserviceable. When power was applied one gauge went immediately to a maximum reading and the other remained at zero. The EGT unserviceability was not entered in the aircraft's maintenance release document.

No evidence (fuel staining) was found which would indicate that fuel had vented from the aircraft in flight. The aircraft performed normally during the ferry flight to Port Hedland following the occurrence.

COMPANY DOCUMENTATION

The company operations manual contains the following requirements:

- Section A:3:6:

'Fuel Usage Records. The aircraft flight time and fuel log sheet includes a section which enables a continuous check of the fuel usage and fuel remaining at the completion of each trip. The pilot in command shall complete this section at the completion of each trip. Fuel used by each aircraft shall be calculated on a monthly basis by the Chief Pilot and fuel consumption determined'.

- Section A:4:6:

'The Pilot in Command is to ensure that sufficient fuel is carried to proceed from the departure aerodrome to the destination aerodrome or alternate aerodrome if required...All company aircraft shall carry a fixed reserve of 45 minutes at the holding rate and a variable reserve of 15% of the flight fuel at the cruise consumption rate. The flight fuel is to be calculated at the consumption rate for each aircraft shown in section B:1:1'.

-Section B:1:1:

'Flight Planning. Use greater of A) 180 knots at 110 litres per hour from departure to destination plus alternate if required, plus 15%, plus 45% (79 litres) or B) single engine use 125 knots 60 litres per hour from critical point to destination plus 15%, plus 10 minutes (18 litres). Taxi Fuel: 10 litres' [plus 45% should read 45 minutes - typographical error].

The operations manual did not contain any information on the determination of fuel contents other than by refuelling the aircraft to full tanks and/or using a manual fuel logging system. Nor did it contain information which would indicate to the pilot that other conditions, such as extended climb time or low altitude operations would affect the fuel burn.

PILOT OBSERVATIONS

The pilot indicated that he was not aware of any method of determining the fuel contents in a BE58, other than by reference to the main fuel gauges, except for refuelling the aircraft to full tanks and maintaining an accurate fuel log from then onwards. The aircraft had been refuelled, for the occurrence flight, at Port Hedland and the pilot had completed fuel drain checks for water at both Port Hedland and Telfer. During the flight from Telfer he had checked the fuel indications each 10 minutes and he did not notice anything abnormal until immediately before the surging started. At that point the pilot noticed that the left fuel gauge was indicating empty and the right gauge 1/4. The right gauge had dropped rapidly to about 1/8 when the right engine also started surging.

The pilot initially thought there was a problem with the contents of the left tank only and that he had sufficient fuel in the right tank to continue to Port Hedland. He was aware that he would arrive at Port Hedland (a further 27 minutes flying) with little or no fuel remaining. His initial decision was to continue with the flight. When the right engine started surging he knew the problem was one of exhaustion rather than starvation and elected to complete a precautionary landing.

As the EGT gauges were unserviceable the pilot relied on the fuel flow gauges to lean the fuel mixture to the cruise setting.

The pilot also indicated that he was concerned that the aircraft could be damaged if it was left parked on the road for any length of time. He did not make an attempt to contact a licensed aircraft engineer to inspect the aircraft before proceeding to Port Hedland as he knew it was unlikely that one would be available at short notice.

FUEL CALCULATIONS

The pilot had determined that 430 L of fuel was onboard the aircraft at Port Hedland, prior to departure, by reference to the company fuel remaining record, for which, as the only pilot of the aircraft since the 100 hourly inspection on 2 June 1994, he had been solely responsible. The record indicated that the fuel tanks had been last filled to capacity on 17 July 1994, and that the aircraft had subsequently flown some 38 hours.

The pilot had maintained the fuel record from that time by:

-including fuel added to the aircraft (using known amounts from drums or refuelling contractors) and

-by deducting fuel used (calculated using 110 L/hour).

The pilot used 110 L/hour for flight times recorded by the flight time meter, plus an allowance for fuel usage during taxi of between zero and 15 L, depending on the actual taxi time. He had determined the 110 L/hour usage rate as a result of a flight to and from Perth in July 1994 which had permitted the use of full fuel tanks. The operations manual also indicated that 110 L/hour should be used for flight planning. Subsequent monthly checks of fuel consumption rates, as required by the company operations manual, had not been completed.

The pilot indicated that he mistrusted the fuel quantity indications provided by both the main fuel indicating system and the wing mounted fuel gauges as their readings did not correspond with the contents indicated by his fuel log. Although he believed the gauging system to be inaccurate, the pilot did not enter it as an unserviceable item in the aircraft's maintenance release. As a result of the pilot's mistrust of the aircraft fuel quantity gauges, the company fuel remaining record was the sole source of fuel quantity information used by the pilot.

During the investigation, the pilot reported that following the incident he had detected an error in the fuel remaining record. An entry on 4th October 1994 indicated a fuel added amount of 200 L when the actual amount had only been 100 L. The pilot indicated that he had ordered, and believed he had received, 100 L per side. However, the fuel docket issued by the refuelling agent indicated a total of 100 L.

CAA SURVEILLANCE

The pilot was interviewed by the CAA on 16 June 1994 and granted CP approval on 20 June 1994. The CAA's Aviation Safety Surveillance Program calls for one operational surveillance visit per year on an operator such as the one involved in this occurrence. No operational surveillance had been carried out since the appointment of the new CP. A CP is appointed only after they have satisfied the authorised CAA officer, at interview, that they have the qualifications, knowledge, and experience to perform the duties set out in CAO 82.0. The authorised CAA officer advised that the CP, in this case, had satisfied the CAO requirements.

ANALYSIS

Cause of the Surging

Possible explanations for the surging were:

1. A non-fuel-related problem in the engines

- This possibility was considered very unlikely as both engines were similarly affected at the same time.

2. Fuel quality problems

- This possibility was considered very unlikely as the previous refuel had been conducted at Port Hedland using high standard refuelling equipment. Further, the pilot had completed fuel drain checks at both Port Hedland and Telfer with negative results.

3. Fuel starvation due to a mechanical defect in the aircraft (such as collapse of the fuel tank bladder) or the fuel system, resulting in interruption of the delivery of fuel to the engine, despite adequate fuel remaining on board the aircraft.

- This possibility was considered unlikely in view of the subsequent successful flight from the incident site to Port Hedland and an inspection of the fuel system did not disclose a collapsed bladder or any other problem.

4. Fuel exhaustion.

- This is considered the most likely cause, and was the focus of the investigation. The following possible reasons were considered.

(a) There were faulty fuel drain valves or the fuel drain valves were not fully closed.

- There was no evidence of fuel leakage around the fuel drain valves to support this possibility.

(b) There was a theft of fuel.

- There was no evidence to support this possibility.

(c) The pilot had miscalculated the fuel contents.

Miscalculation of fuel contents

An analysis of the flight suggests that the likely fuel on departure from Port Hedland, assuming a usage rate of 113 L/hour (based on information provided by the aircraft owner), 10 L taxi allowance and fuel exhaustion, was 226 L.

This figure was determined by calculating the flight fuel (Port Hedland to Telfer was 69 mins @ 113 L/hour for a sub-total of 130 L and Telfer to the incident site was 40 minutes @ 113 L/hour for a sub-total of 76 L) and adding the taxi fuel (two periods of taxiing @ 10 L each for a sub-total of 20 L).

As the calculated amount of fuel was 226 L, a discrepancy of 204 L existed with the 430 L calculated on the pilots fuel remaining record. Whilst 100 L was accounted for earlier in the report, a discrepancy of 104 L remained. This amount may be attributable to an actual fuel flow rate in excess of 110 L/hour. Over the 38 flight hours since the last positive check of fuel on board, a rate of 113 L/hour would account for the discrepancy.

A difference of 3 L/hour is not considered significant, on any single flight if the pilot is aware of the actual fuel state on departure, as it would be adequately covered by the variable (15%) and fixed reserve (45 minutes) that must be carried as part of the operations manual requirements. However, such a small difference can be significant over a longer period of time as was the case leading up to this occurrence. Had the pilot, in his role as CP, carried out the monthly calculation of fuel usage, as required by the operations manual, he probably would have been aware of the higher than expected fuel usage rate and made allowances for it.

SIGNIFICANT FACTORS

1. The pilot was not sufficiently aware of all the methods for determining the actual fuel contents.

2. The use of 110 L/hour for both fuel planning and actual consumption was insufficient to cover all types of operations in the Beechcraft Model 58.

3. As CP, the pilot did not calculate the actual fuel consumption on a monthly basis therefore he deprived himself of more accurate fuel consumption figures on which to base his fuel log.

4. The pilot believed, probably incorrectly, that the fuel indicating systems were inaccurate and as a result he did not make sufficient use of them in his fuel calculations.

5. When convinced that the fuel indicating system was too inaccurate to use, the pilot did not place the system unserviceable. This deprived him of another method of determining the fuel contents.

6. Both exhaust gas temperature gauges were unserviceable and the pilot did not attempt to have them repaired. This deprived him of accurate fuel mixture control which, in turn, may have led to a higher than expected fuel consumption.

7. The pilot made an error in one entry in his fuel log which created the impression that the aircraft contained 100 L more fuel than it actually did.

8. The operator's documentation either did not provide sufficient fuel management guidance to the pilot or the guidance was incorrect.