No: 9/86 **Ref: 1b**

Aircraft type and registration:	Piper PA31-Navajo G-BFON	
No & Type of engines:	2 Lycoming T1O-540-A2B piston engines	
Year of Manufacture:	1969	
Date and time (UTC):	11 June 1986 at 1145 hrs	
Location:	1/2 mile north of RAF Brize Norton, Oxon	
Type of flight:	Private (crew positioning)	
Persons on board:	Crew — 1	Passengers — 2
Injuries:	Crew — 1 (minor)	Passengers — 2 (minor)
Nature of damage:	Aircraft destroyed	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	37 years	
Commander's Total Flying Experience:	7000 hours (of which 150 were on type)	
Information Source:	AIB Field Investigation.	

History of the flight

The commander had flown the aircraft from its base at Cardiff to Bristol (Lulsgate) earlier that day, and returned to Cardiff where the aircraft was refuelled. The two inboard tanks were filled, and physically checked. This required a total of 61 US gallons but the distribution of uplifted fuel between the left and right tanks was not recorded. A fuel system crossfeed check was not carried out that day. The right fuel contents gauge was known to be unserviceable and the needle would, on occasions, stick beyond the FULL indication.

The aircraft was then flown to Oxford (Kidlington), with a passenger in the right front seat, in order to embark and transport a company pilot back to Cardiff. On arrival at Kidlington the aircraft was obliged to execute a missed approach and an abbreviated additional circuit due to conflicting traffic. The commander recalls that a noticeable amount of left aileron was required to maintain a wings level attitude. The aircraft made a normal landing at 1127 hrs. After taxying to the control tower, the left engine was shut down, and the additional passenger boarded. The left engine was then restarted and the aircraft taxied out to the holding point of runway 02. Both passengers had noticed a smell of petrol at this time and remarked on it, but it later dissipated.

Subsequent enquiries revealed that a ramp employee at Kidlington had noticed what he took to be fuel venting from the vicinity of the underside of the right engine nacelle, and as the day was warm he thought this unremarkable. Significant fuel stains were also found at the control tower parking area, and holding point and threshold of runway 02. Prior to take-off the newly embarked passenger noticed that the right fuel gauge was reading beyond FULL (a problem of which he was aware) and that the left gauge was indicating approximately one quarter full. He was reassured by the commander that both gauges had been "playing up".

The aircraft departed Kidlington at 1133 hrs, the take-off and initial climb to 1500 feet being uneventful. Radio contact was made with Brize Norton Zone Controller who requested the aircraft to climb to 2000 feet on the Brize Norton QFE of 1005 millibars. This was complied with, and at 1140 hrs the aircraft experienced surging of one, then both engines culminating in a complete loss of power at a position 5 nautical miles north north west of Brize Norton. The commander advised the controller that an engine problem had developed and that he was turning southwards towards the airfield. He subsequently declared a Mayday after opening the crossfeed and switching on the two electric fuel pumps to no avail. The commander stated that up until that time he had been on straight feed, ie right inboard tank feeding the right engine and left inboard tank feeding the left engine, with the crossfeed OFF. The commander also stated that during the unsuccessful attempts to restart the engines, the tank selectors remained as selected as he was aware of the physical presence of fuel in both inboard tanks prior to the departure from Cardiff, and uncertain of the contents of the outboards. The company pilot seated behind the front seats recalled the right fuel gauge was still reading over FULL, and that the left gauge was indicating empty.

The commander decided that a forced landing short of the airfield was inevitable, and lowered the gear. The passengers were also warned to tighten their seat belts. At approximately 250 feet above ground level, the mixture levers were pulled back to idle cut off, and the magneto switches thought to have been selected to OFF.

The aircraft landed in a field of standing barley and the nose gear detached causing the nose and right wing to strike the ground, the aircraft to rotate approximtely 180° to the right, and the main gear to collapse. On impact, the right engine caught fire immediately followed by the cabin, with fire spreading rearwards along the aisle. The two front seat occupants left by the left main door, the rear passenger by the right overwing exit. Minor injuries were suffered, the commander being detained in hospital for 24 hours with burns.

The aircraft was destroyed by a severe fire, which was extinguished by an appliance from RAF Brize Norton using 30 gallons of Fluroprotein foam, and 600 gallons of water. The NCO in charge reported that two or three flashbacks were experienced from fuel leaking under the right side of the aircraft and igniting on hot spots under the mainplane.

The weather was fine with a light and variable wind.

Technical aspects

Examination of the accident site indicated that the aircraft's final approach was along a heading of 224° magnetic into 3 feet of standing barley, slightly left wing low and with the propellers rotating at about 1000 rpm. The ground marks suggest that after about 50 feet of ground roll the nose landing gear broke off, bringing the aircraft's nose and right wing tip into violent contact with the ground and resulting in the aircraft rotating rapidly to the right. The aircraft came to rest, with its main landing gear collapsed, facing approximately back along its path through the crop. The fire then gutted the fuselage and damaged the right wing extensively, particularly around the wing root and engine nacelle.

The on-site examination of the fuel tanks showed there to be approximately 5 US gallons and 13 US gallons in the left and right outboard tanks respectively. Approximately 2 US gallons remained in the right inboard tank but the left inboard tank showed only traces of fuel. The fuel selectors were found with both left and right sides selected to the inboard tanks and the crossfeed selected ON. As found, the fuel gauges indicatd 1/8 full on the left-hand side and beyond FULL on the right. The magneto and electric fuel pump switches, also mounted in the overhead panel, were found to be burned away and their final position could not be established. The screwjack in the roll trim-actuator was found in a position corresponding to 35% left trim.

The aircraft was removed to AIB Farnborough for examination, particularly of the fuel system (see diagram) which is designed to operate with the left and right sides independent of each other unless the crossfeed valve is opened.

Enquiries of the operator showed that although there had been numerous instances of the right fuel gauge sticking at FULL, the left gauge had worked satisfactorily. The examination was

initially focussed on the possibility of fuel leaks and, as the left-hand side of the fuel system had been only slightly damaged by the fire, extensive leak testing was performed on this side and the operation of the electrical fuel pump was confirmed. On the right-hand side there was considerable fire damage and so the examination took the form of a detailed inspection of the components of the fuel system on this side; no leak could be found on either side which would account for fuel loss in flight. It became evident, however, that the initial impact had disrupted the right-hand engine firewall and fractured the fuel supply pipe behind it, allowing fuel to fall onto the hot exhaust manifold, and that the right inboard fuel tank had ruptured following a structural failure between its supporting panels. The deformation of the supporting panels under the right inboard tank, and its absence elsewhere, indicated that there was a large amount of fuel in this tank at impact, and that this fuel would then have flowed freely into the right-hand wing root.

The fuel selector panel on the PA31-310 Navajo is located on the aircraft centre line at floor level and slightly behind the pilots' seats, nested against the main spar with a pair of fuel gauges overhead showing the contents of the tanks selected. A rigging check of the crossfeed selector showed that the OFF and ON detents did correspond to closed and open states of the crossfeed valve respectively; the crossfeed valve, however, would open at about 25% of the lever travel towards ON. Similar rigging checks on the left and right fuel tank selectors showed that the fuel selector valves would open at about 50% of the lever travel from OFF to INBOARD.

Aircraft fuel consumption was assessed from published performance data and from the correlation of the aircraft usage and fuelling records over the previous month. The total amount of fuel consumed by the two engines, since the last refuelling at Cardiff, was calculated to be approximately 58 US gallons. The capacity of each inboard tank is 56 US gallons.

PA-31-310 FUEL SYSTEM