Australian Government
Australian Transport Safety Bureau

Fuel starvation and forced landing involving Piper PA-28, VH-BDB

15 km WSW of Bankstown Airport, New South Wales, 19 September 2017

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Addendum

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Fuel starvation and forced landing involving Piper PA-28, VH-BDB

What happened

On 19 September 2017, at about 1504 Eastern Standard Time,[1] the pilot of a Piper PA-28-181 aircraft, registered VH-BDB (BDB), conducted a forced landing about 15 km west-south-west of Bankstown Airport, New South Wales. In addition to the pilot, there was one passenger on board. The pilot received minor injuries and the passenger was uninjured. The aircraft was substantially damaged.

On 15 September, the pilot made a booking to hire an aircraft from Bankstown Airport for a return flight to Wollongong with one passenger, for the time period 1200–1500. The booking was made with the flight school where the pilot had recently completed his private pilot licence and had flown the PA-28 aircraft type. The purpose of the planned flight was for the pilot to accrue command hours towards his commercial pilot licence.

On 19 September, after arriving at the flight school and finalising his flight plan, the pilot was advised that the booked aircraft was unserviceable and the booking was changed to 1230–1530 with an alternate aircraft. The alternate aircraft returned at about 1240–1250 from the previous booking and was then refuelled to full. The pilot conducted his pre-flight inspection and elected to start the flight with a few circuits at Bankstown Airport before departing to Wollongong with the passenger. While conducting the circuits, the aircraft became unserviceable and the pilot returned the aircraft to the flight school.

The school then offered the pilot BDB. The pilot agreed to take BDB, but decided to conduct a local training area flight due to the time delays associated with the aircraft changes. The pilot reported that he conducted a pre-flight inspection of BDB. He believed the aircraft had full fuel on board on departure and planned to fly for only 30–40 minutes. Therefore, he did not intend to change the fuel tank selector during the flight from the tank selected at take-off (refer to section titled *Fuel management*).

At about 1430, the pilot and passenger departed for a local training flight, with a planned return time of about 1500. At about 1500, as the aircraft was approaching the waypoint 2RN for return to Bankstown, the pilot noticed the engine was fluctuating a couple of hundred revolutions per minute. The pilot elected to track via Camden to avoid overflying built-up areas with what he believed to be an engine problem. After turning towards Camden, the pilot selected the electric fuel pump on, but the engine fluctuations became worse. The pilot then performed his engine failure immediate checks, which involved checking the fuel pump, mixture, oil temperatures and pressures, switches for the magnetos, and throttle for response.

After the pilot completed his immediate checks, there was a total loss of engine power, at which time the aircraft was at an altitude of about 700 ft above ground level. The pilot identified a field out to his left, made a MAYDAY[2] call to Bankstown air traffic control, and briefed his passenger to secure himself for the landing.

There was moderate turbulence, which resulted in fluctuating airspeed and intermittent stall[3] warning activations during the approach. Considering the conditions, low altitude and the location of the fuel tank selector, the pilot felt that attempting to change fuel tanks would have diverted his

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1 Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.

2 MAYDAY: an internationally recognised radio call announcing a distress condition where an aircraft or its occupants are being threatened by serious and/or imminent danger and the flight crew require immediate assistance.

3 Aerodynamic stall: occurs when airflow separates from the wing's upper surface and becomes turbulent. A stall occurs at high angles of attack, typically 16˚ to 18˚, and results in reduced lift.

attention from flying the aircraft at a critical time. Therefore, the pilot focused his attention on not stalling the aircraft while executing the forced landing, and did not conduct any further checks.

After the aircraft touched down, the pilot concentrated on keeping it straight over the rough ground until it ran through a fence at the end of the field and stopped when the right wing struck a tree. The pilot activated the emergency locator transmitter and directed his passenger to stand about 30–40 m behind the aircraft. After the pilot exited the aircraft, he activated his personal locator beacon and made a phone call to emergency services as he could see fuel leaking from the right wing. Emergency services arrived within about 20 minutes and made the accident site safe.

Fuel management

Fuel system

The PA-28-181 aircraft has two fuel tanks, one in each wing, and a fuel gauge located in the cockpit for each tank. A three position fuel selector is located on the lower left side of the cockpit with the positions OFF, LEFT and RIGHT. The rate of fuel consumption in-flight is about 42 L/h and each tank held a total of 90 L. The last fuel system calibration was 19 February 2014.[4] The calibration check found the fuel tanks were empty when the fuel gauges indicated zero. When the fuel gauges indicated 5 USG,[5] the left tank held 17 L and the right tank held 16 L. When the fuel gauges indicated 10 USG, the left tank held 33 L and the right tank held 35 L.

Pilot's instruction and practices

The pilot's flying school reported that they teach pilots that fuel gauges are not always accurate. Therefore, if a fuel tank(s) was not full during the pre-flight inspection, a dip-stick located in the aircraft was used to check the tank(s) contents. For in-flight fuel management and aircraft balance, the pilot was taught to change the fuel selector between the LEFT and RIGHT tank at 30 minute intervals. Consequently, the pilot managed fuel in-flight based on flight time, rather than with reference to the fuel gauges.

In the event of a loss of engine power, the pilot was taught to complete the entire emergency checklist procedure provided there was sufficient height and/or time available. However, if he believed the loss of power had occurred in a time critical situation, then he should prioritise flying and safely landing the aircraft in lieu of conducting checks.

Operator's report

The operator reported that, at the completion of the previous flight, BDB had about 25 L in the left tank and about 55 L in the right tank. The local fuel agent used by the operator also reported that BDB was not refuelled before the flight.

Aircraft inspection

A representative of the insurance company examined the aircraft about 3 hours after the forced landing. That examination found the fuel selector in the LEFT tank position (Figure 1) and no usable fuel in the left tank, which was not breached. The right tank, which was breached, was about one quarter full. The aircraft wreckage was recovered to facilities on 21 September and further inspections were conducted on 26 September. The inspections found no fuel in the engine fuel lines, and about 20 ml and 40 ml of fuel in the fuel filter bowl drain valve and carburettor respectively.

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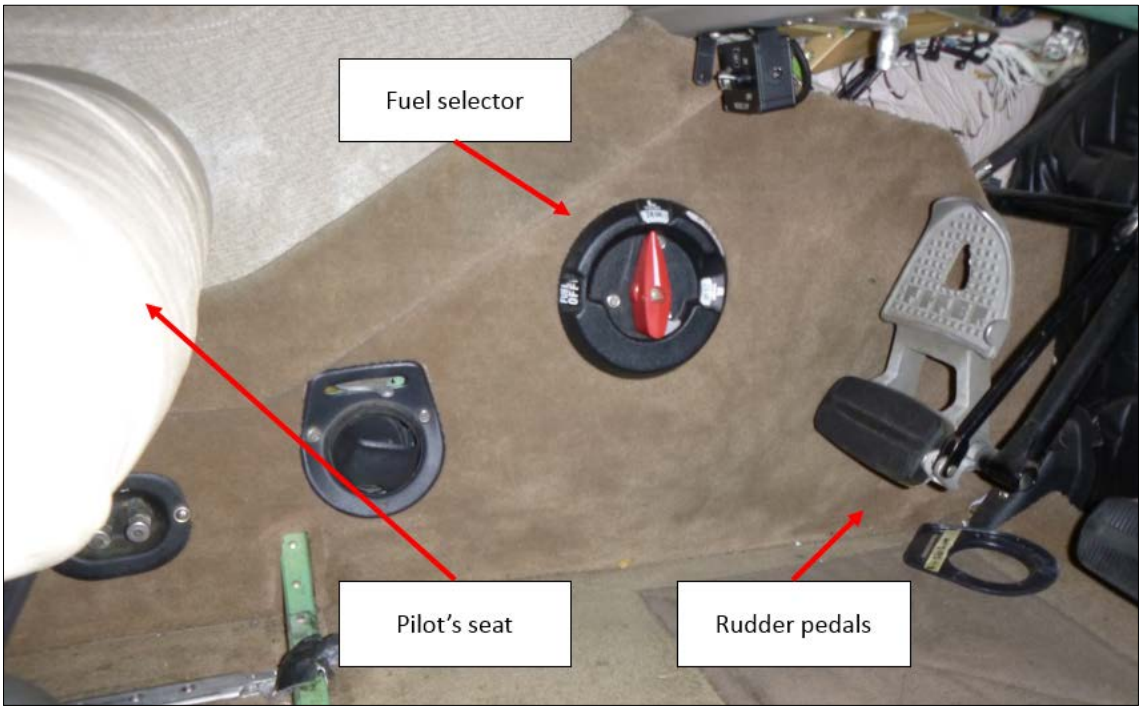
[4] The calibration check interval is 48 months in accordance with Civil Aviation Order 100.5. The fuel quantity gauges must be checked with the aircraft positioned to simulate the normal level flight attitude, which may be different to the aircraft attitude on the ground. A placard must be displayed in the fuel gauge scale errors exceed +/- 5% of the nominal fuel tank capacity.

[5] 1 United States Gallon (USG) = 3.8 L.

Figure 1: Aircraft fuel tank selector



Source: Insurance assessor, modified by the ATSB

Quick reference handbook

The flight school had a published quick reference handbook for the PA-28 aircraft, which included an abnormal procedure for *engine roughness* and an emergency procedure for *engine power loss in flight*. The *engine roughness* procedure started with carburettor heat on, followed by adjusting the mixture, electric fuel pump on, switching fuel tanks, checking engine gauges and magnetos. The *engine power loss in flight* procedure started with switching fuel tanks, electric fuel pump on, mixture to full rich, carburettor heat on, check engine gauges and fuel primer.

Safety analysis

Believing the aircraft had full fuel on board, the pilot intended to conduct the 30-40 minute flight on the left fuel tank. It was more likely than not that the pilot believed the fuel quantity on board was full at the start of the flight due to his inspection of another aircraft earlier in the day. However, BDB was not refuelled prior to the flight and had about 35 minutes of fuel available in the left tank and about 78 minutes in the right tank. Despite having sufficient fuel on board for the planned flight, when returning to Bankstown, the engine lost power due to fuel starvation associated with use of the left fuel tank. This resulted in a forced landing.

While the pilot conducted some initial checks before the engine completely lost power, he omitted to change fuel tanks, which likely would have prevented the subsequent loss of engine power. Once the aircraft experienced a total loss of power, the pilot found himself in a time-critical situation in challenging flying conditions and therefore prioritised flying the aircraft in lieu of conducting further checks.

Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- The pilot had refuelled another aircraft to full earlier in the day, which he more likely than not misattributed to the fuel state of VH-BDB.
- The loss of engine power was due to fuel starvation associated with the left fuel tank, which resulted in the pilot conducting a forced landing.

Safety message

Fuel starvation and exhaustion events continue to be reported to the ATSB. It is therefore important for pilots to continue to educate themselves on the risks and controls associated with fuel management.

Methods for cross-checking fuel on board before flight are published by the Civil Aviation Safety Authority in *Civil Aviation Advisory Publication 234-1: Guidelines for aircraft fuel requirements*.

Case studies for pilots to learn about fuel management related accidents have been published by the ATSB in *Avoidable Accidents No. 5 – Starved and exhausted: Fuel management aviation accidents*.

General details

Occurrence details

Date and time:	19 September 2017 – 1504 EST	
Occurrence category:	Accident	
Primary occurrence type:	Operational - fuel related - starvation	
Location:	15 km WSW of Bankstown Airport, New South Wales	
	Latitude: 33° 56.03’ S	Longitude: 150° 49.07’ E

Aircraft details

Manufacturer and model:	Piper Aircraft Corporation PA-28-181	
Registration:	VH-BDB	
Serial number:	2843425	
Type of operation:	Private – pleasure / travel	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – 1 (minor)	Passengers – 0
Aircraft damage:	Substantial	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A

primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.