Australian Government
Australian Transport Safety Bureau

Fuel starvation involving Cessna 210, VH-HZE

11 km N of Mildura Airport, Victoria, 6 February 2017

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Aviation Occurrence Investigation
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Addendum

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Fuel starvation involving Cessna 210, VH-HZE

What happened

On 6 February 2017 at around 0730 Australian Eastern Daylight-saving Time (AEDT), the pilot of a Cessna 210 aircraft, registered VH-HZE, departed Mildura Airport, Victoria, for Broken Hill Airport, New South Wales (NSW), to conduct a private business flight under visual flight rules.[1]

The pilot had been to the airport the previous afternoon to prepare the aircraft, which included filling the two fuel tanks.

After arriving in Broken Hill an hour after departure, the pilot was joined by two work colleagues. From Broken Hill, they flew for 40 minutes to Katalpa Station, NSW, to visit clients. After Katalpa, they flew 30 minutes to Pine View Station, NSW, to visit other clients. From Pine View Station, the pilot flew 45 minutes back to Broken Hill to drop off their two work colleagues. After departing Broken Hill, the pilot tuned the radio to Mildura aerodrome weather information service (AWIS) to check the weather. The weather was cloudy, but suitable for a visual approach.

Approximately 70 NM (130 km) from Mildura, the pilot listened to the AWIS again. The AWIS advised that there was broken[2] cloud at Mildura at 4,000 ft and visibility was 10 km.

Passing 12 NM (22 km) on approach to Mildura, the pilot made a broadcast to advise that they were approaching the airport. The pilot reported that during the approach, the AWIS indicated that the cloud base was varying between 1,000 ft and 3,000 ft. Therefore, the pilot decided to approach Mildura overhead to observe the conditions.

Approaching the airport, the pilot noticed the weather was overcast over the airport, but clear on the northern side of the Murray River.

The pilot manoeuvred the aircraft initially to the east and then to the north of Mildura for about 20 minutes before they set up for a straight-in approach for runway 18. Once established on the approach, they started descending. They were about to make a broadcast that they were joining a straight-in approach to runway 18 when the engine stopped. The pilot then made a MAYDAY[3] call to Melbourne Centre.

The pilot had been flying the aircraft with the fuel tank selector set to both tanks. They cycled the selector to the right tank and switched on the auxiliary fuel pump, but there was no response from the engine. The pilot noticed that their fuel flow computer was indicating 90 L of fuel remaining when the engine failed.

The pilot decided not to attempt to land on the runway as they would have had to fly over a populated area and instead identified Amaroo Road as suitable for a forced landing. On approach, they noticed there were powerlines on both sides of the road and changed their landing site to a nearby paddock.

The pilot landed the aircraft in the paddock and collided with a fence during the ground roll. Once the aircraft had stopped, the pilot selected the master switch to off and exited the aircraft uninjured. The aircraft was substantially damaged (Figure 1).

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1 A set of regulations that permit a pilot to operate an aircraft only in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

2 Used to describe an amount of cloud covering the sky of between five and seven okta (eighths).

3 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.

Figure 1: Damage to HZE

Source: Pilot

Pilot comments

The pilot provided the following comments:

- At most, the trip would take 4 to 4.5 hours, so fuel was not expected to be an issue.
- The fuel selector was selected to both tanks.
- There were no abnormal engine indications, or sounds from the engine to indicate that the engine was about to fail.

Fuel management

The pilot reported they filled the tanks with around 197 L the evening before. This was consistent with the amount of fuel they believed was used from the last flight, around 200 L. Overall, after refuelling, the total amount of useable fuel on board should have been 435 L. Their planned fuel flow was about 75 L per hour. Therefore, their planned endurance with full fuel tanks was just under six hours. The pilot recorded they were flying for four hours and 15 minutes before the engine failed.

The pilot reported that the aircraft was parked with the left wing low at the fuel point and when they refuelled the fuel tanks in the wings, so they might have stopped before the tanks were full. However, the pilot reported that the fuel gauges indicated the tanks were about full. The pilot advised that they visually checked the fuel levels the next morning, but did not use a dipstick. The fuel caps are on the wing tips which makes visually checking the fuel level difficult.

The aircraft was installed with a fuel flow computer known as an EDM 930 (also known as a JPI). The fuel flow computer tracks the fuel flow to the engine to calculate fuel remaining. The pilot must enter the fuel on board the aircraft at the start of the flight, as the computer does not take fuel measurements from the fuel tanks.

After the engine is started, there is a prompt on the computer to enter whether any fuel was added to the aircraft. If no fuel is added to the tank, the user can exit the screen, otherwise they can choose ‘next’ to select ‘yes’ if fuel was added which automatically resets to a quantity of 435 L.

Upon approach, the fuel gauge indicated the left tank was near empty, but the right was half full.

The Cessna fuel system is designed so fuel can be drawn from either the right tank or the left tank or from both tanks at the same time. The pilot advised that they normally flew with the fuel selector on both tanks. They advised that during the cruise at 4,000 ft, they had leaned the fuel mixture.

After the accident, an inspection was conducted which found the left fuel tank was empty and the right tank had 25 L of fuel remaining, half of which was useable. The Cessna 210 manual states that if the aircraft is flown out-of-balance when fuel tanks contents are one quarter full or less, then the fuel tank outlets can uncover, causing fuel starvation and engine stoppage. The fuel selector was selected on 'right tank', but the pilot had advised that this was selected after the engine had failed.

Weather

The Bureau of Meteorology provided a weather report with the aerodrome forecasts.

The amended aerodrome forecast (TAF)[4] which was valid at the time of the accident was broken clouds at 1,500 ft, with rain and visibility was greater than 10 km. It also forecast intermittent periods of broken cloud at 600 ft with visibility of 5,000 m with rain. These conditions were still suitable for a visual flight.

Previous occurrences

A search of the ATSB's database found 12 occurrences in 2016 where fuel starvation led to an engine failure. Two examples are:

- On 18 April 2016, a Lancair ES aircraft took off from an airstrip near Mansfield, Vic. and was climbing to about 500 ft when the engine lost power (ATSB investigation AO-2016-037[5]). The pilot established the aircraft in a glide and conducted a forced landing. The maintenance personnel assessed the reason for the power loss was fuel starvation as the aircraft was parked on an incline prior to taxi and fuel may have drained away.
- On 12 August 2016, the pilot of a Cessna 172 was conducting powerline inspections near White Cliffs, NSW (ATSB occurrence 201602162). After finishing checking a powerline, the engine lost power and the pilot conducted a forced landing. The engineering inspection revealed the engine failed due to a lack of useable fuel in the left fuel tank.

Safety analysis

The pilot thought the aircraft had been filled to the maximum fuel level because they had considered how much the fuel was used the previous flight, which was 200 L, and the tanks did not appear to take more fuel at 197 L. The ground where the aircraft was refuelled was on an incline which meant the aircraft had its left wing down, so the left tank may have appeared full before it actually was, as the refuelling points are on the end of the wing. The aircraft was parked on level ground overnight, to ensure fuel did not leak out through the breather. The following morning, the fuel was checked visually in the tank, but not physically by using a dipstick. Therefore, it is uncertain whether the aircraft was filled with the maximum fuel level.

The pilot was using the fuel flow computer for fuel usage monitoring, however, it does not provide a direct reading of fuel contents from the fuel tanks, only fuel flow. The fuel remaining is calculated by the computer by subtracting the fuel consumed in-flight from the fuel manually entered by the pilot at the start of the flight. Only the fuel gauges provide the pilot with an indication of the actual amount of fuel left on board.

While circling Mildura Airport attempting to find a break in the clouds to land, the pilot conducted numerous turns with both fuel tanks were selected. However, as the left tank was likely to be

[4] A statement of meteorological conditions expected for a specific period of time in the airspace within a radius of 5 NM (9 km) of the aerodrome reference point.

[5] https://www.atsb.gov.au/publications/investigation_reports/2016/aair/ao-2016-037/

empty at that time, it is probable the right fuel tank outlet was uncovered during the manoeuvring, resulting in fuel starvation and subsequent engine failure.

Given the fuel burn rate and the remaining usable fuel on board, the aircraft had about 10 minutes of flying time remaining before complete fuel exhaustion.

Findings

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

- The engine failed due to fuel starvation when the limited amount of fuel remaining in only one of the two tanks became unusable during manoeuvring.
- Prior to departure, the aircraft's fuel tanks were probably not full. However, the pilot selected full fuel tanks on the fuel flow computer and therefore the fuel flow computer provided the pilot with a higher reading of fuel on board than what was actually on board.

Safety message

The investigation is a reminder of the importance of monitoring fuel levels prior to – and during – the flight. When monitoring the fuel levels, it is important to note the limitations of flight instruments. The ATSB has published a report *Avoidable Accidents No. 5 - Starved and exhausted: Fuel management aviation accidents* which outlines strategies in fuel management.

General details

Occurrence details

Date and time:	6 February 2017 – 1637 EST	
Occurrence category:	Accident	
Primary occurrence type:	Fuel starvation	
Location:	11km N of Mildura	
	Latitude: 34° 07.82' S	Longitude: e.g. 142° 06.32' E

Aircraft details

Manufacturer and model:	Cessna 210N	
Registration:	VH-HZE	
Serial number:	P21000859	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 0	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.