LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10514										
Classification	Accident			**Date**	10 October 2024			**Time**	1517Z		
Type of Operation	Private (Part 91)										
Location											
Place of Departure	Bethlehem Aerodrome (FABM), Free State Province			Place of Intended Landing				New Tempe Aerodrome (FATP), Free State Province			
Place of Occurrence	Left of the N5 Road between Senekal and Winburg, Free State Province										
GPS Co-ordinates	Latitude	28°24'19.40" S		Longitude	027°25'59.80" E			Elevation	4 795 feet		
Aircraft Information											
Registration	ZS-MCY										
Make; Model; S/N	Beech Aircraft Corporation; 58 (Serial Number: TH764)										
Damage to Aircraft	Substantial					Total Aircraft Hours		6 234.9			
Pilot-in-command											
Licence Type	Private Pilot Licence (PPL)				Gender	Male			Age	56	
Licence Valid	Yes	Total Hours			604.3		Total Hours on Type			93.5	
Total Hours Past 30 Days	6.8				Total Hours on Type Past 90 Days			16.6			
People On-board	1 + 0	**Injuries**	0	**Fatalities**	0		**Other (on ground)**		0		

What Happened

On the afternoon of 10 October 2024, a pilot on-board a Beech 58 aircraft with registration ZS-MCY took off on a private flight from Bethlehem Aerodrome (FABM) to New Tempe Aerodrome (FATP) near Bloemfontein in the Free State province. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot, a specialised surgeon, had planned to attend to patients in Mbombela and Bethlehem before he could return to Bloemfontein in his four-day trip. At the pilot's request, the aircraft was prepared by the aircraft maintenance organisation (AMO) based at FATP. On Monday morning, 7 October 2024, the aircraft was parked at the apron. The pilot, who is part-owner of the aircraft, stated that during his pre-flight inspection he checked the external fuel level sight gauges that are located on each wing (see Figure 6). He later took off from FATP to Nelspruit Aerodrome (FANS), the duration of this flight was 2 hours and 12 minutes (2.2 hours). The aircraft was then parked at FANS until Thursday morning, 10 October 2024. Early on Thursday morning, the pilot flew from FANS to Bethlehem Aerodrome (FABM) where he consulted during the day. This flight was also 2 hours and 12 minutes (2.2 hours). At approximately 1454Z that afternoon, the pilot took off from FABM to FATP.

The pilot stated that approximately 20 minutes after take-off from FABM, one of the engines started to splutter and, thereafter, stopped. The pilot then checked the fuel gauges on the instrument panel, and both indicated empty. During an interview with the investigator, the pilot made the following statement about the fuel gauges: *"These gauges always under-read by as much as half a tank, so I always relied upon the outside (wing) gauges when preparing for flights. These outside gauges are tricky to read through the Perspex or glass coverings, especially when there is sunlight glare and even more so when stressed and, in a hurry, and under the false impression that the tanks are as full as expected. Furthermore, due to the extra-large tanks, the centrally mounted, 360° needles point in the same direction when the tanks are either empty or full. Also, the needles have two ends, a sharp end that should be used, and a diametrically opposite blunt end that should be ignored."*

The pilot further stated that he realised that the aircraft was out of fuel and that the second engine would also stop. Therefore, he declared an emergency with Johannesburg Central on frequency 120.30-Megahertz (MHz). At this time, he had identified a useful, long straight stretch of the National Road (N) 5 between Senekal and Winburg. As he approached the road, he performed a 360° turn to the left and then touched down as there were no vehicles on the road in his immediate vicinity. The road was approximately 12 metres (m) wide and comprised three lanes and a shoulder on each side (see Figure 1). Before touching down, he switched off the master switch and the magnetos and tried to turn the fuel selectors to the OFF position (*the two selectors were found turned inwards to the cross-feed position, see Figure 8*). During the landing roll, which was upslope, the aircraft veered to the left of the road. The left-wing tip struck several safety hazard (chevron) boards next to the road and impacted a stormwater barrier (see Figure 2) which caused the aircraft to yaw violently. The aircraft came to rest on the left side of the road and faced towards the road. According to the pilot, the landing gear did not extend when he selected it to the DOWN position. There were no skid markings of the lower fuselage on the surface of the road that would indicate that the landing gear did not extend. The landing gear lever was found in the DOWN position. The pilot had bruises after the accident; the aircraft was substantially damaged.

Sector Times and Fuel Consumed

The table below shows the actual times and fuel consumed, recorded by the aircraft's JPI EDM 790 engine data management system, which is presented in United States (US) gallons.

From	To	Flight time	Fuel left engine	Fuel right engine	Total amount of fuel used
Bloemfontein	Nelspruit	02:12	29.2	29.2	58.4
Nelspruit	Bethlehem	02:12	23.1	23.1	46.2
Bethlehem	Engine failure	00:28	5.5	5.5	11
Totals		04:52	57.8	57.8	115.6

The aircraft was fitted with the 172 US gallon fuel tanks. The JPI EDM engine data log showed that the aircraft had a total of 116 gallons (58 US gallons on each side) of usable fuel on-board before

take-off from FATP. The flight time for all three sectors included start and taxi. The fuel used from the left tank for all three sectors was 57.9 US gallons, and from the right tank was 57.5 US gallons. The fuel on-board was depleted after 4 hours and 52 minutes. The POH, Section 2, Limitations states: "*Do not take off if Fuel Quantity Gauges indicate in Yellow Arc or with less than 13 US gallons in each wing fuel system".* The pilot ignored this POH notice.

Establishing Fuel Quantity Before Flight

Full fuel – can be established by inspecting the cockpit fuel gauges, removing the filler caps and visually inspecting the tanks. Regarding the regulations, fuel uplifts should be recorded in the aircraft flight folio. These entries with corresponding invoices can be useful in maintaining an awareness of the aircraft's fuel consumption rate and quantity available. The fuel uplifts for the past eight flights had not been recorded in the flight folio for this aircraft.

50 – 70% fuel – by using the external fuel level sight gauges and the cockpit fuel gauges.

0 – 50% fuel – by using the cockpit fuel gauges and by deduction using a fuel consumption log.

The aircraft was equipped with a JPI EDM 790 engine management system that provides accurate fuel consumption and fuel quantity information. At start up, the system requires confirmation of one of three options; reset to full, enter fuel uplift, or no uplift. It seems that the pilot did not make use of the fuel management function on the JPI EDM 790.

The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 28°24'19.40" South 027°25'59.80" East, at an elevation of 4 795 feet (ft).

Figure 1: The N5 road, with the aircraft at a distance.

Figure 2: The stormwater barrier and two of the hazard marker boards that the aircraft impacted.

Figure 3: The aircraft as it came to rest next to the road.

Figure 4: Substantial damage to the left wing.

Figure 5: An aft view of the aircraft next to the N5.

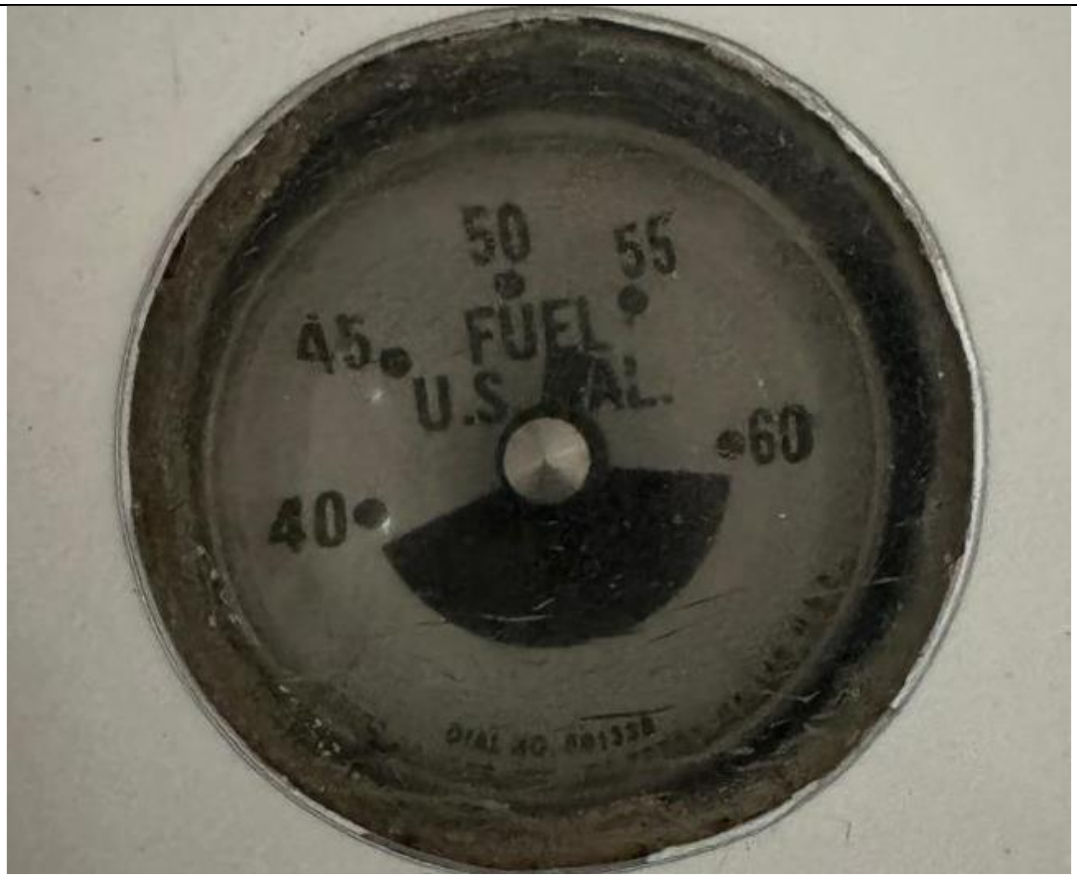


Figure 6: External fuel level sight gauge with the needle in the seven o'clock position. These gauges only provide readings if the fuel quantity is between 40 and 60 US gallons. *The picture had been enlarged as this is a small gauge*.

Figure 7: The fuel gauges in the cockpit with the landing gear lever in the DOWN position.

Meteorological Information

The weather information in the table below was obtained from the pilot questionnaire.

Wind Direction	270ºC	Wind Speed	5-10 knots	Visibility	9999m
Temperature	Unknown	Cloud Cover	Scattered	Cloud Base	10 000ft
Dew Point	Unknown	QNH	1024hPa		

The meteorological aerodrome report (METAR) was obtained from the South African Weather Service (SAWS) website, issued for FABM on 10 October 2024 at 1500Z.

FABM 101500Z 18007G20KT 9999 SCT025 28/M01 Q1024=

Wind Direction	180º	Wind Speed	7 knots gusting 20kt	Visibility	9999m
Temperature	28ºC	Cloud Cover	Scattered	Cloud Base	2 500ft
Dew Point	-1ºC	QNH	1024hPa		

Fuel System (Source: Pilot's Operating Handbook (POH), Section 7, Systems Description)

"The fuel system is an OFF-ON-CROSSFEED arrangement. The fuel selector panel, located on the floor forward of the front seats, contains the fuel selector for each engine and a schematic diagram of fuel flow.

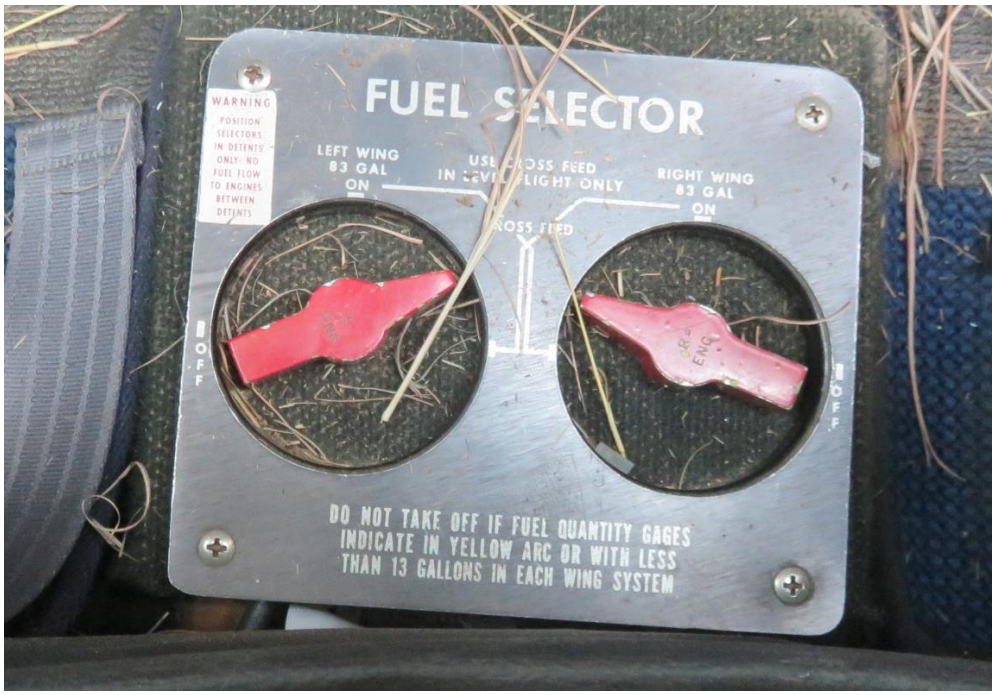


Figure 8: The fuel selector as it was found on site.

The standard wing fuel system has a total capacity of 142 US gallons. Two optional systems are available. The first has a total capacity of 172 US gallons; the second, comprising the 172 US gallon system plus wet wing tip tanks provides a total capacity of 200 US gallons. The fuel value placard adjacent to each filler cap indicates fuel capacity and useable fuel when that wing fuel system is full.

A vapor return line returns excess fuel from the engine to the respective wing system. All of the fuel cells, standard or optional, in each wing are interconnected in order to make all the useable fuel in each wing available to its engine when the fuel selector valve is turned to ON. The standard 142 US gallon and optional 172 US gallon fuel systems are filled through a single filler located in each wing.

The standard 142 US gallon fuel system and the optional 172 US gallon fuel system have six drain locations. Two additional drain locations are provided when the wet wing tip tanks are installed.

The fuel quantity is measured by float-type transmitter units which transmit the common level indication to a single indicator for each respective wing system.

A visual fuel level sight gauge in each wing leading edge, outboard of the engine nacelle, can be used for partial filling or off-loading of fuel. This gauge is to be used only when it reads within the calibrated areas, which are between 40 to 60 US gallons (see Figure 6).

The subject aircraft was fitted with the 172 US gallons fuel capacity (see Figure 9), 86 US gallons on either side, of which 83 US gallons were usable.

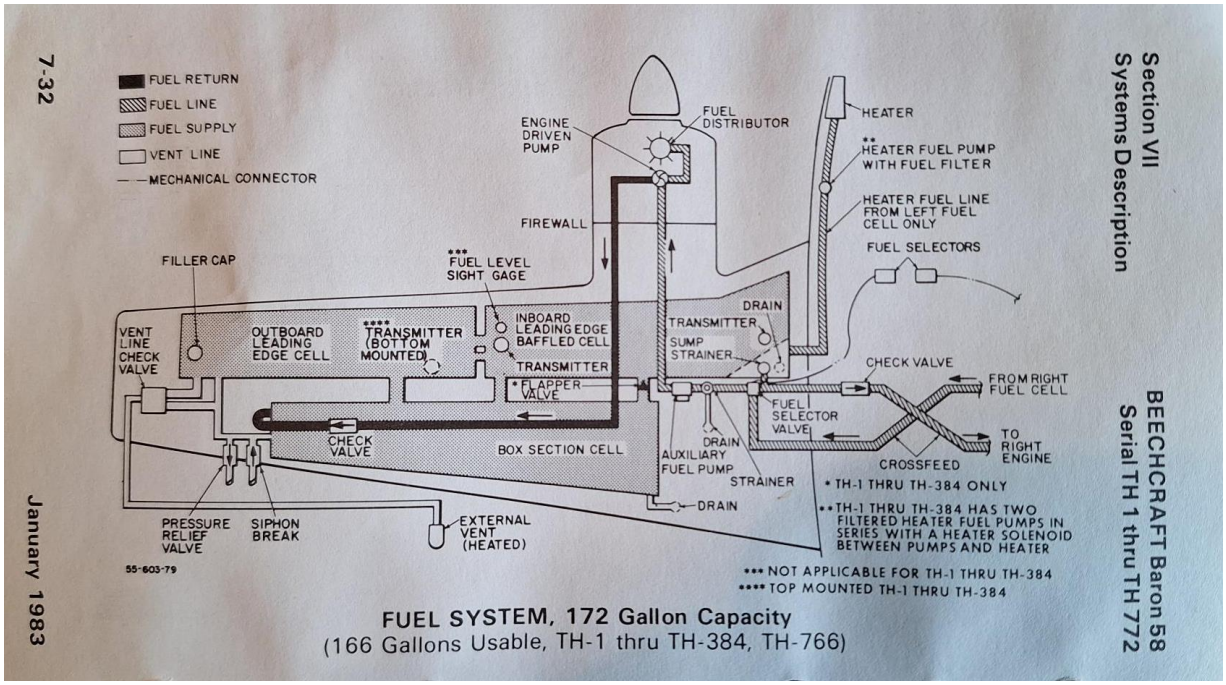


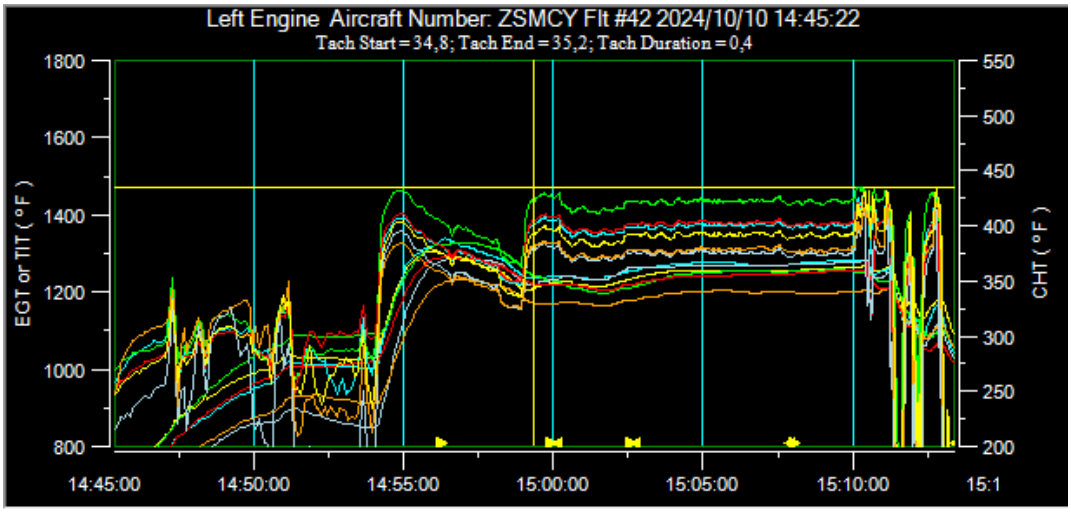
Diagram 1: The fuel system of the aircraft. (Source: POH)

JPI EDM 790

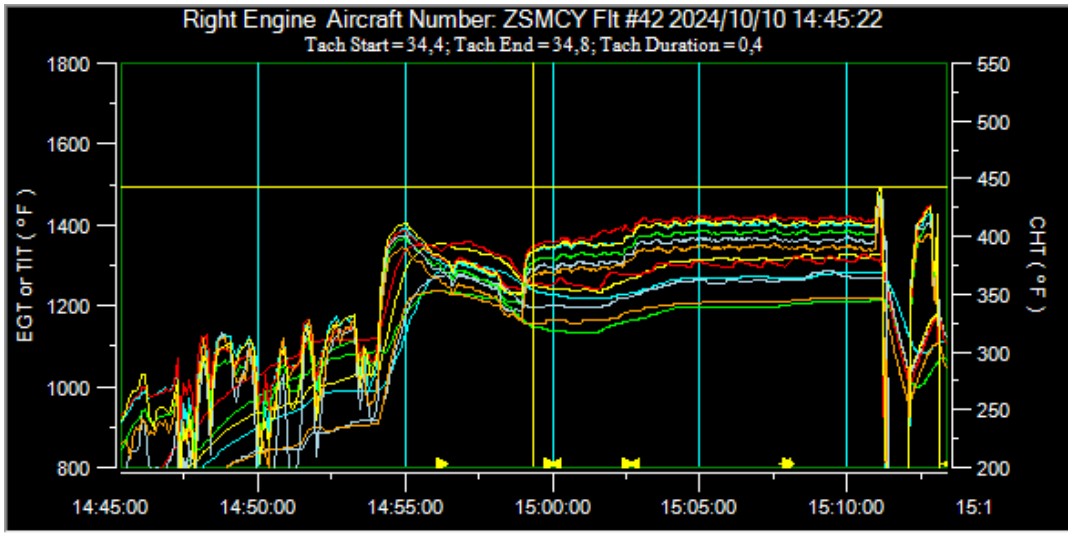
The aircraft was fitted with a JPI EDM 790 engine data management system. The unit also had a fuel flow monitoring capability. The unit records several engine parameters, including Exhaust Gas Temperature (EGT), Cylinder Head Temperature (CHT), Oil Temperature (OILT), and Fuel Flow (FF) in gallons per hour (GPH) for reciprocal engines.

Based on data that was downloaded from the unit (Graphs 1 and 2), the two engines shut down at the same time.

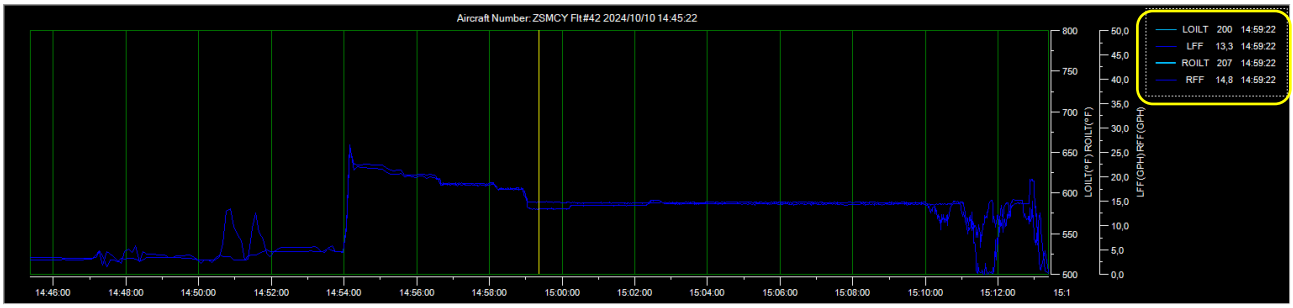
Figure 9: The JPI EDM 790 unit that was installed in the aircraft.



Graph 1: The JPI EDM 790 data for the left engine, accident flight.



Graph 2: The JPI EDM 790 data for the right engine, accident flight.



Graph 3: In this graph the average fuel flow for the left and right engine is displayed in gallons per hour. The time from start-up to take-off was approximately 8 minutes.

Civil Aviation Regulations (CARs)

Several CARs were contravened during the operation of this aircraft. These include the failure to complete the flight folio properly regarding every flight and the associated time of each flight, as well as fuel and oil uplifts. Parts 91.03.5 and 91.03.6 are clear on the requirements to which pilots must adhere.

Part 91.02.7 is clear on the fuel requirements to which the pilot-in-command (PIC) must adhere. The regulations are clear on the amount of fuel that must be on-board the aircraft for each flight, which include take-off and climb, cruise, descend (including flying an instrument approach should it be required), missed approach, deviation to an alternate aerodrome, and a reserve of 45 minutes.

Part 91.02.8 refers to the responsibility of the PIC to ensure that the safety of the flight and its occupants, which may include cargo, are not compromised in any way.

Part 91.07.12 states that a "*pilot shall not commence with a flight unless he or she is satisfied that the aircraft is carrying sufficient amount of usable fuel and sufficient oil to complete the planned flight safely and to allow for deviations from the planned operation.*"

Findings

1. Personnel Information

1.1 The pilot had a Private Pilot Licence (PPL) that was initially issued by the Regulator (SACAA) on 6 October 2015. The latest issued PPL had an expiry date of 31 October 2024. The pilot had flown a total of 604.3 hours of which 93.5 hours were on the aircraft type.

1.2 The pilot was issued a Class 2 aviation medical certificate on 15 February 2024 with an expiry date of 28 February 2025. The pilot was restricted to carry a pair of reading spectacles in the aircraft.

1.3 The pilot stated that the fuel gauges on the instrument panel were inaccurate and that he relied on the external fuel level sight gauges.

1.4 The pilot did not make entries in the aircraft flight folio for any of the flights since he departed from FATP. This was in contravention of Part 91.03.5 of the CAR 2011 as amended.

1.5 There were no flight folio entries for fuel and oil uplifts as called for in Part 91.03.6 of the CAR for the past eight flights of this aircraft.

1.6 The POH states the following in Section 2, Limitations: *"Do not take off if Fuel Quantity Gauges indicate in Yellow Arc or with less than 13 US gallons in each wing fuel system".*

1.7 The pilot was the sole occupant on-board the aircraft, and the weight and balance was not a factor, even with full fuel tanks.

1.8 The pilot elected to land on a long straight stretch of the N5 that had no traffic at the time.

1.9 Both engines stopped in operation due to fuel exhaustion. The pilot did not adhere to Part 91.07.12 of the CAR which states: *"(1) A pilot-in-command of an aircraft shall not commence a flight unless he or she is satisfied that the aircraft is carrying sufficient amount of usable fuel and sufficient oil to complete the planned flight safely and to allow for deviations from the planned operation."*

1.10 The pilot did not comply with Part 91.02.7 of the CAR which states: *(1) The PIC of an aircraft shall not commence a flight unless he or she is satisfied that — (j) the requirements in respect of fuel, oil, oxygen, weather, minimum safe altitudes, aerodrome operating minima and availability of alternate aerodromes for the route being flown and any likely alternatives, whether flown under instrument or VFR, are complied with.*

1.11 The pilot did not comply with Part 91.02.8 of the CAR which states: *(1) The PIC of an aircraft shall, whether manipulating the controls or not, be responsible for — (a) the operation, safety, and security of the aircraft, crew members, passengers, and cargo in accordance with these regulations while he or she is in command.*

2. <u>Aircraft Information</u>

2.1 The last maintenance inspection of the aircraft was certified on 17 April 2024 at 6 217.1 airframe hours. The aircraft had accrued 17.8 hours since the said inspection.

2.2 The aircraft's Certificate of Registration (C of R) was issued to the present owner on 26 May 2021.

2.3 The aircraft had a valid Certificate of Airworthiness (C of A) that was issued on 27 December 1989 by the Regulator (SACAA). The latest C of A had an expiry date of 31 December 2024.

2.4 The aircraft was issued a Certificate of Release to Service (CRS) on 17 April 2024 at 6 217.1 airframe hours with an expiry date of 16 April 2025 or at 6 317.1 airframe hours, whichever comes first.

2.5 The aircraft was fitted with a JPI EDM 790 engine data management system which also recorded fuel flow information. This unit was downloaded, and the data for all three flights was obtained and used to compile this report.

2.6 The propeller fitted to the left engine was feathered, and the one fitted to the right engine was not.

2.7 The landing gear lever in the cockpit was found in the DOWN position.

2.8 The pilot opted to land with the flaps in the UP position.

2.9 The total fuel capacity of this aircraft is 172 US gallons (652 litres) of which 166 US gallons (628 litres) were usable.

2.10 The external fuel level sight gauges are small, and a person needs to look closely to obtain an accurate reading. These gauges only display a reading if the fuel quantity in the tanks is between 40 and 60 US gallons.

2.11 According to the flight folio entries of previous flights between FABM and FATP, the flying time was approximately 50 minutes.

2.12 The POH has no emergency procedure for a twin-engine stoppage; it only presents a single-engine failure/stoppage procedure.

3. Meteorological Information

3.1 Based on the weather information provided by the pilot, fine weather conditions prevailed at the time of the flight. The weather had no bearing on this accident.

4. Road used for Landing

4.1 The road was in good condition and consisted of three lanes which provided ample space to land. There was no traffic on the road in the immediate area at the time of landing. The part of the road on which the aircraft landed was upslope (see Figure 5).

Probable Cause

Following a dual engine stoppage in-flight due to fuel exhaustion, the pilot landed the aircraft on a National Road (N5) and lost directional control which resulted in the left wing striking several road hazard markers next to the road as well as a stormwater barrier. The aircraft came to rest in a trench next to the road.

Contributing Factors

1. The pilot displayed a total disregard for standard safe operating procedures.
2. The pilot neglected to perform a proper pre-flight inspection before departure from FATP, which included ensuring the aircraft was refuelled to capacity (he did not open the fuel tank filler caps to physically inspect the fuel level).
3. The pilot neglected to perform a proper pre-flight inspection before departure from FABM.
4. The pilot failed to conduct proper flight planning.

Safety Action(s)

None.

Safety Recommendation

None.

About this Report

The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an investigation, and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up desktop inquiries to bring awareness of potential safety issues to the industry in respect of this occurrence, as well as possible safety action/s that the industry might want to consider in preventing a recurrence of a similar occurrence.

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011 and ICAO Annex 13, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not apportion blame or liability.

Disclaimer

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa