AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9748		
Aircraft Registration	ZS-PBR	**Date of Accident**	9 November 2018		**Time of Accident**	1620Z	
Type of Aircraft	Partenavia P68C-TC		**Type of Operation**		Test flight (Part 43)		
Pilot-in-command Licence Type	Commercial Licence		**Age**	34	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours	1514.7			Hours on Type	4.9	
Last point of departure	Lanseria Aerodrome (FALA) Gauteng Province						
Next point of intended landing	Lanseria Aerodrome (FALA) Gauteng Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Hartebeesfontein Road at GPS 25°51'14.15" South 027°37'25.41" East, at an elevation of 4 206 feet							
Meteorological Information	Wind: Variable at 5kt, Temp 26°C, Dew point 6°C, Visibility 10km.						
Number of people on board	1+0	**No. of people injured**	0	**No. of people killed**	0		
Synopsis							

On 9 November 2018 at 1320Z, a pilot took off from Lanseria International Airport (FALA) following a mandatory periodical inspection (MPI), the flight was conducted as a maintenance check flight with the intention to land back at FALA. The pilot completed the post MPI checks and initiated the testing of the on-board camera system. After completing the testing of the camera system, he routed back to FALA. Prior to the flight, the pilot stated that he uplifted 218 litres (l) of fuel, which resulted in the aircraft having a total of 520l of fuel on-board, a full capacity for this type of aircraft. The flight was conducted under visual flight rules (VFR) by day. Fine weather conditions prevailed at the time leading up to the accident.

During the entire flight, the pilot noticed that the right-hand fuel gauge was dropping, while the left-hand side was indicating full. The pilot stated that he had to compensate for the imbalance during the flight by cross-feeding from the left tank to both the left and right engines. This intervention did not correct the imbalance between the left and the right tank indication, therefore, he elected to switch both fuel selectors back to feed both engines from their respective tanks. The pilot further stated while crossing the ridge line of the Magaliesberg mountain, the right engine surged and, shortly thereafter, it stopped. The left engine also stopped shortly after the right engine. He identified a road to execute an emergency landing. During landing, the aircraft clipped small trees alongside the road before impacting with bigger trees and a brick wall with its left wing. The aircraft then came to rest facing in north-west direction. The aircraft was substantially damaged and there were no injuries reported by the pilot. Evidence found on the left propeller blades showed that the left engine was operating under partial power at impact.

The investigation revealed that the aircraft was flown with the cross-feed selected to supply fuel from the right tank for both engines. As a result, the fuel depleted quickly from the right engine and it stopped. When the right engine stopped, the pilot switched the fuel selectors to supply from the left tank and, in the process, omitted to switch on the left auxiliary fuel pump. Because only the right fuel pump was switched on, this caused a vacuum in the left engine fuel supply line, limiting fuel supply to the engine which was configured to operate at cruise power. This resulted in the left engine losing power, making it impossible to sustain a safe flight. The pilot then elected to perform a forced landing.

SRP Date	19 September 2019	Publication Date	17 October 2019

ABBREVIATION	DESCRIPTION
AD	Airworthiness Directive
AFM	Aircraft Flight Manual
AME	Aircraft Maintenance Engineer
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
ATC	Air Traffic Control
ATNS	Air Traffic Navigation Services
ATO	Aviation Training Organisation
°C	Degrees Celsius
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
CORS	Certificate of Release to Service
C of R	Certificate of Registration
CPL	Commercial Pilot Licence
CVR	Cockpit Voice Recorder
ENAC	Ente Nazionale per l'Aviazione Civile
FAA	Federal of Aviation Administration
FALA	Lanseria Aerodrome
FDR	Flight Data Recorder
ft	Feet
GPS	Global Positioning System
hPa	Hectopascals
KIAS	Knots Indicated Air Speed
kt	Knots
L	Litre(s)
m	Metre(s)
MHz	Megahertz
MPI	Mandatory Periodic Inspection
Nm	Nautical Mile
PIC	Pilot-in-Command
QNH	Query Nautical Height
SACAA	South African Civil Aviation Authority
SA-CARS	South African Civil Aviation Regulations
SB	Service Bulletin
TMA	Terminal Manoeuvring Area
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency

Reference Number	**:** CA18/2/3/9748
Name of Owner/Operator	**:** AOC Holding Pty (Ltd)
Manufacturer	**:** Partenavia
Model	**:** P68-TC
Nationality	**:** South African
Registration Marks	**:** ZS-PBR
Place	**:** Hartebeesfontein Road, Gauteng
Date	**:** 9 November 2018
Time	**:** 1620Z

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

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, 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 to apportion blame or liability****.*

Investigations process:

The accident was reported to the Accident and Incident Investigation Division (AIID) on 9 November 2019 at about 1630Z. The Investigator/s drove to the accident site (Hartebeesfontein Road) the following day on 10 November 2019. The Investigator/s coordinated with all authorities on site by initiating the accident investigation process according to CAR Part 12 and investigation procedures. The AIID of the South African Civil Aviation Authority (SACAA) is leading the investigation as the Republic of South Africa is the State of Occurrence.

Notes:
1. Whenever the following words are mentioned in this report, they shall mean the following:

- *Accident — this investigated accident*
- *Aircraft — the Partenavia P68-TC involved in this accident*
- *Investigation — the investigation into the circumstances of this accident*
- *Pilot — the pilot involved in this accident*
- *Report— this Accident report*

2. Photos and figures used in this report are taken from different sources and may be adjusted from the original for the sole purpose of improving the clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer:

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1 On 8 October 2018, a Partenavia P68-TC with registration markings ZS-PBR underwent a 100-hour mandatory periodic inspection (MPI) at an approved aircraft maintenance organisation (AMO) after being on the ground for 19 months since its last flight on 12 March 2017. The MPI was completed on 7 November 2018, however, there was no certificate of release to service (CRS) issued. The aircraft was fitted with an on-board aerial camera/survey (APPL ANIX) system during maintenance which started on 8 October 2018. After the completion of the MPI on 7 November 2018, the aircraft underwent a post MPI maintenance check flight. The pilot uplifted an additional 218 litres (l) of Avgas fuel before the flight, bringing both fuel tanks to capacity at 520l. This is according to the fuel slip supplied by the pilot to the investigators.

1.1.2 On 9 November 2018 at 1320Z, the pilot, being the sole occupant on-board the aircraft, took off from Runway 07 in Lanseria International Airport (FALA) on a post MPI maintenance check flight with the intention to land back at FALA. He was also requested to test the fitted on-board camera during the same flight. According to the air traffic control (ATC) transcript, the pilot was given take-off clearance at 1320Z on frequency 124.00 Megahertz (MHz). The flight was conducted under the provisions of Civil Aviation Regulations (CAR) 2011, Part 43 as amended.

1.1.3 During the flight, the pilot noticed that the right-hand fuel gauge was dropping while the left-hand side was showing full. The pilot recalled having to compensate for the fuel imbalance during the flight by cross-feeding from the left tank to both engines. This intervention did not correct the imbalance between the left and the right tank indication. He then elected to switch both fuel selectors back to feed both engines from their respective tanks.

1.1.4 While flying over the Magaliesberg mountain range on the return flight to FALA, the aircraft's right engine surged and, shortly thereafter, it stopped. The pilot stated that the left engine also stopped shortly after the right engine. The pilot identified a road to execute an emergency landing. During landing, the aircraft clipped small trees alongside the road before impacting bigger trees and a brick wall with its left wing. The aircraft then came to rest facing in north-west direction. The aircraft was substantially damaged and there were no injuries reported by the pilot.

1.1.5 According to the fuel slip, the pilot uplifted an additional 218 litres (l) of Avgas fuel before the flight, bringing both tanks to capacity at 520l on-board.

1.1.6 The accident occurred during dusk at a geographical position determined to be 25°51'14.15" South 027°37'25.41" East, at an elevation of 4 206 feet (ft) above mean sea level (AMSL). Fine weather conditions prevailed at the time of the accident.

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	1	-	-	-

1.3. Damage to Aircraft

1.3.1 The aircraft was substantially damaged.

Figure 1: Aircraft as it came to rest.

1.4. Other Damage

1.4.1 Limited to a section of a perimeter wall as can be seen on Figure 1.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	34
Licence Number	**********	Licence Type	Commercial Pilot		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Tug, night rating, instrument rating, instructor grade 3				
Medical Expiry Date	31 August 2019				
Restrictions	None				
Previous Accidents	None				

Note: The pilot was issued with a medical certificate on 28 August 2018, with an expiry date of 31 August 2019 and with no restrictions.

Flying Experience:

Total Hours	1514.7
Total Past 90 Days	38.5
Total on Type Past 90 Days	4.9
Total on Type	4.9

1.5.1 According to available information, the pilot did a conversion for the type on 6 November 2018 at an approved Aviation Training Organisation (ATO) where he completed the following systems: Electrical, flight controls, landing gear, fuel, ventilation, stall warning and avionics. The ATO found the pilot to be competent on theory and type technical oral test. A system familiarisation was found to have been completed and an overall briefing time of 3.0 hours was achieved.

1.5.2 According to the information brought forward by the instructor who did the pilot's conversion on the P68, it was revealed that a one-hour flight simulator and a one-hour actual flight were accomplished by the pilot during the type conversion. The conversion onto P68 was signed out on 07 November 2018. Since the conversion, the pilot only accrued 2.9 hours on type, which added to a total of 4.9 with conversion hours included. The pilot's last competency check for a commercial pilot licence (CPL) aeroplane was done on 13 January 2018, with an expiry date of 31 January 2019.

1.5.3 According to the information provided by the pilot, he flew a total of 583 hours as a pilot-in-command (PIC) on multi engine aircraft.

1.6 Aircraft Information

1.6.1 The Partenavia P68C-TC, serial number 359-40, was manufactured in 1985. The aircraft is a light, twin-engine, high-wing aeroplane, fitted with a fixed tricycle undercarriage. The aircraft was fitted with an on-board camera system installed in the cabin area on the last MPI. The aircraft is powered by 2 Lycoming IO-T10-360 engines with fuel injection.

Airframe:

Type	P68C-TC	
Serial Number	359-40	
Manufacturer	Partenavia	
Date of Manufacture	1985	
Total Airframe Hours (At time of Accident)	4937.5	
Last MPI (Date & Hours)	7 November 2018	4934,6
Hours since Last MPI	2.9	
C of A (Issue and Expiry Date)	18 June 2007	17 June 2018
C of R (Issue Date) (Present owner)	7 August 2008	
Operating Categories	Part 135	

1.6.2 Fuel flow from the wing tanks to the engines is controlled by three (3)-position fuel selector control knobs, one for each engine. The selector knobs enabled the pilot to select which tank to feed which engine. Normally the fuel selector knobs would be selected for direct tank-to-engine flow; that is, the right engine fuel selector knob would be set to the right tank and the left engine selector knob to the left tank. Alternatively, cross-feed could be selected allowing for flow from a tank to the opposite engine, or if required from one tank to both engines. For example, if the left engine selector knob was rotated to its right tank setting, fuel from the right tank would feed both engines. The left tank setting on the right engine selector allowed fuel from the left fuel tank to also feed both engines. The final position was for fuel shut-off on the right-hand engine and intermediate between left-hand and right-hand tanks for the left-hand engine as depicted in Figure 4.

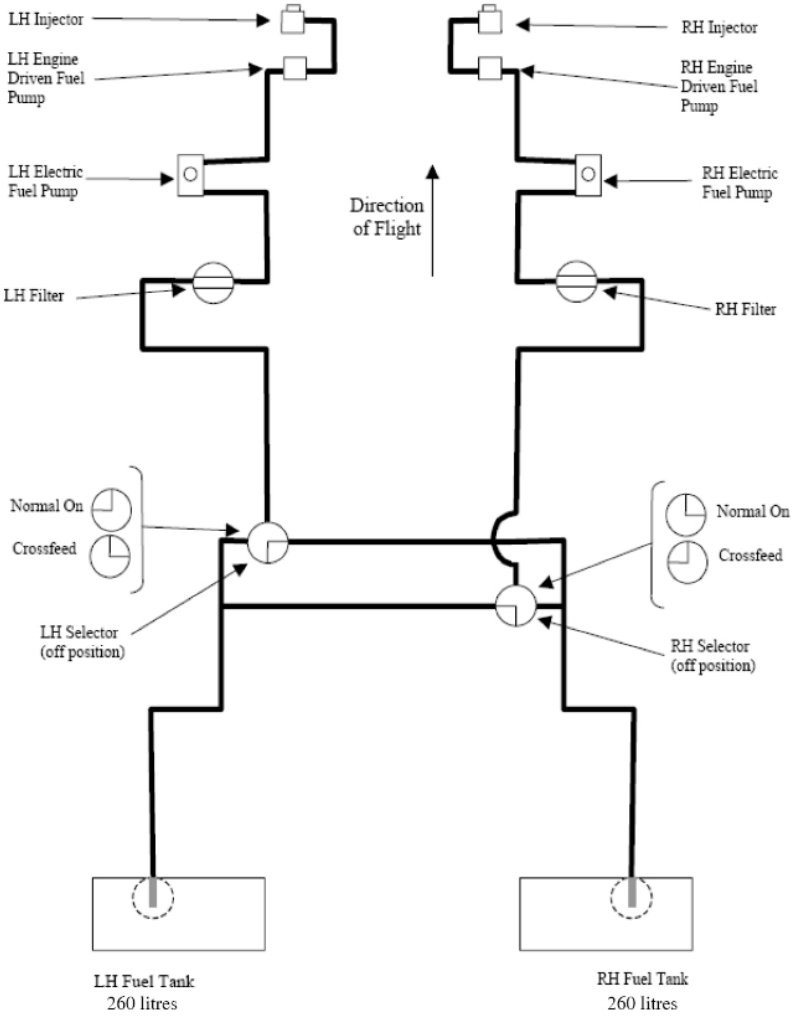


Figure 2: Schematic diagram of fuel system.

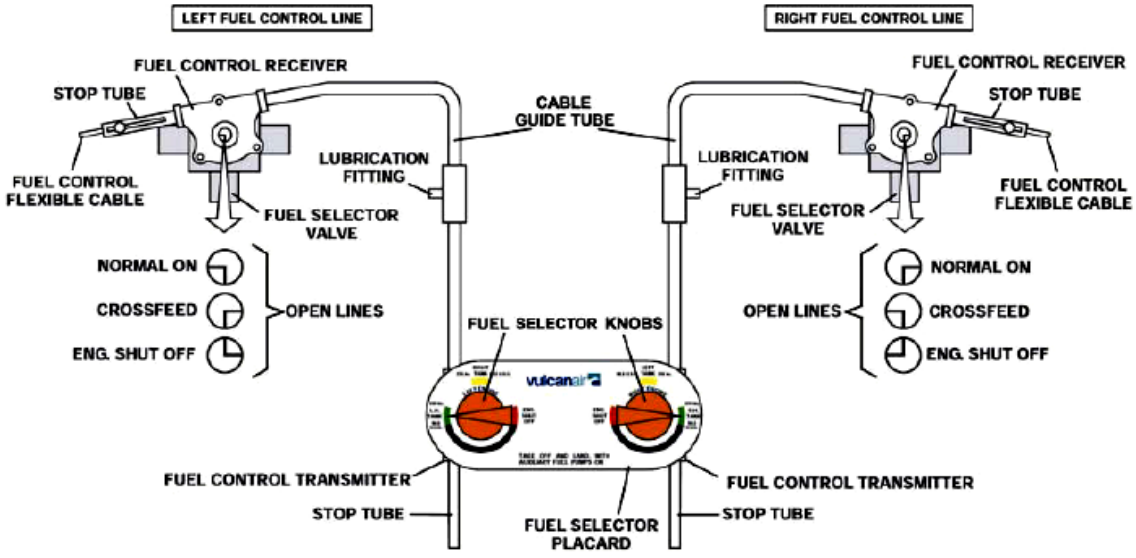


Figure 3: Fuel control system architecture.

Figure 4: Positon of the fuel valve selectors as found at the accident site.

1.6.3 According to the flight folio, the aircraft last flew on 12 March 2017. The post MPI maintenance check flight was conducted on the day of the accident. The operator, as it supplies the pilots who carry out the post maintenance checks, was requested by the AMO to issue a letter authorising that the post maintenance test flight could be carried out. The letter issued by the operator indicated that the post maintenance test flight be carried out on ZS-OYN and not ZS-PBR as requested by the AMO.

1.6.4 According to the on-board aircraft file, the certificate of airworthiness (C of A) expired on 17 June 2018. The inspection reminder in the file and the certificate of release to service (CRS) had also lapsed on 29 September 2017 or at 4994.4 airframe hours.

1.6.5 According to the South African Civil Aviation Authority's (SACAA) ZS-PBR aircraft file, the last information received from the AMO was in May 2018 of an application for renewal of a C of A. No further supporting documents were received by the SACAA since the last submission to complete the renewal of C of A.

1.6.6 According to the CAR 2011, Part 91.03.6 "*no owner or operator of an aircraft shall operate a South African registered aircraft without holding a valid certificate of release to service signed by the holder of an appropriately rated AME licence or AMO approval."*

1.6.7 According to the aircraft flight manual (AFM), the total fuel capacity of this aircraft is 538 litres, of which 260 litres is usable fuel per tank and 9 litres is unusable fuel per tank. The fuel consumption for this aircraft is 45.6 litres per hour per engine. The aircraft took off with both tanks filled to capacity and the aircraft was flown for 2.9 hours. This would amount to approximately 265 litres of fuel used.

1.6.8 It was also noted that the airframe logbook service bulletin pages were full, and the new book was not opened yet. According to the aircraft maintenance work pack and the airframe logbook, there was no entry found which indicated that the service bulletin 113 was complied with during the last maintenance check completed on 7 November 2018, Mandatory Service bulletin 113 issued by the aircraft manufacturer. The section applicable to service bulletin was full and the last entry was on page 81, however, the AMO used previous pages and, on page 75, there was an entry for 7 November 2018 which stated that *nil AD's, SB's, SI's and SL's applicable at this time*. The purpose of the service bulletin 113 was to supply more detailed instructions for the operational check of the fuel selector control system, scheduled for every 100 flight hours as per the Ente Nazionale per l'Aviazione Civile (ENAC) approved current maintenance programme.

Engine 1:

Type	Lycoming IO-T10-360
Serial Number	L-174-64A
Hours since New	5372.5
Hours since Overhaul	2.9

Note: According to the engine logbook, the Lycoming IO-T10-360 engine with serial number L-174-64A was overhauled by an approved AMO on 30 September 2018 at 5369.6 hours since new. After the engine overhaul, the engine was refitted on the aircraft on 30 October 2018 by an approved AMO. The engine accrued 2.9 hours since installation after being overhauled and that brings the total hours since new to 5372.5.

Engine 2:

Type	Lycoming IO-T10-360
Serial Number	L-178-64A
Hours since New	Not recorded in the logbook
Hours since Overhaul	1707.4

Note: According to the engine logbook, the total hours since new are unknown for the right-hand engine. The AMO informed the investigators that the aircraft logbooks were transferred to them with engine hrs since new missing.

According to the Lycoming service instruction L180B, it is required by the operator or aircraft owner to preserve the engine for long-term storage, if it is known that an aircraft is to remain inactive for 30 or more days. The right-hand engine was not removed nor preserved in accordance with SL L180B. It was noted that the aircraft had been out of service from March 2017 to November 2018. According to CAR Part 43.02.21 "Aircraft withdrawn from service for storage shall meet the preservation instructions of the aircraft's manufacturer as prescribed in the relevant maintenance manuals, service bulletins, service letters or service instructions for the inoperative period. Before such an aircraft is returned to service, any prescribed maintenance shall be carried out prior to release to service". It was also noted that the left-hand engine was removed for overhaul during that period. During the interview with the AMO, they highlighted to the investigators that as part of preservation, they ran the right-hand engine from time to time. There was neither evidence found or presented for such engine ground runs.

Propeller 1:

Type	Hartzell Prop
Serial Number	AU 7649
Hours since New	4438.8
Hours since Overhaul	2.9

Propeller 2:

Type	Hartzell Prop
Serial Number	AU 7642
Hours since New	3674.8
Hours since Overhaul	2.9

Note: According to the engine logbook, the aircraft had a propeller strike on a serial number AU7642 propeller during an emergency landing on 10 March 2005. The propeller was overhauled and was refitted at total propeller time of 373.49 hours on 19 September 2006 by an approved AMO who issued a certificate relating to maintenance. During the removal of the left-hand engine on 12 July 2017, both propellers were removed and sent for overhaul. They were installed back to the aircraft during the MPI on 30 October 2018 by the AMO.

1.7 Meteorological Information

1.7.1 The weather information below was obtained from the pilot questionnaire.

Wind direction	Variable	Wind speed	5kt	Visibility	10km
Temperature	26°C	Cloud cover	Unknown	Cloud base	Unknown
Dew point	06°C	QNH	Unknown		

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with the standard factory-fitted navigational equipment approved by the Regulator. No defects to this equipment were recorded prior to the flight.

1.8.2 Secondary radar track.

Figure 5: Radar image before the crash. (Picture coutersy of FALA)

Note: The radar image above provided by FALA Air Traffic and Navigation Services (ATNS), depicts the flight path of the aircraft minutes before the crash. It was noted that after the aircraft crossed the Magaliesberg mountain ridge line, it made a descending right turn before radar was lost. The radar started tracking the aircraft at 17.34 nautical miles (nm) from FALA airfield at a height of 6000 feet (ft). It was noted that the aircraft continued with that height until it crossed the ridge. The radar images showed a steady descend up to the point where the aircraft reached a height of 4900ft above mean sea level (AMSL). That is when the radar contact was lost at 1610Z.

1.9 Communication

1.9.1 The aircraft was equipped with standard communication equipment as approved by the regulator. No defects were recorded or experienced with communication system during the flight. All communication conducted with the relevant parties were conducted through radio communication.

1.10 Aerodrome Information

1.10.1 The accident did not happen at an aerodrome but at Hartebeesfontein Road which is located 17nm east of FALA. The nearest landing strip to the accident site is The Coves private aerodrome, which is 800m from the accident site.

Aerodrome Location	The Coves	
Aerodrome Co-ordinates	25°46’42.0” S 027°46’36.0” E	
Aerodrome Altitude	3885 ft	
Runway Headings	18	36
Runway Dimensions (Length/Width)	900m X 20m	900m X 20m
Runway Used	Not applicable	
Runway Surface	Grass	
Approach Facilities	None	
Radio Frequency	125.4 – Unmanned airfield procedures apply	

1.11 Flight Recorders

1.11.1 The aircraft was neither equipped with a flight data recorder (FDR) nor a cockpit voice recorder (CVR), nor was it required for this type of aircraft.

1.12 Wreckage and Impact Information

1.12.1 The aircraft approached Hartebeesfontein Road from an easterly direction and the pilot lowered the nose to fly the aircraft underneath the electrical wires to avoid colliding with wires. Witness marks on the ground showed that the aircraft touched down with both main gears 34.2m from the electrical wires and continued with the landing roll while veering off to the left of the road before the left-hand wing impacted a set of small trees alongside the road at 45.2m from touchdown. The left wing and propeller collided with several small trees located on the left of the road.

At approximately 54.8m from the tree that was severed, a rock was found with metal imprints and shavings, indicative of impact with the rotating left-hand propeller as seen in Figure 7. Small rocks on the left-hand side of the road also showed metal shavings and impact marks.

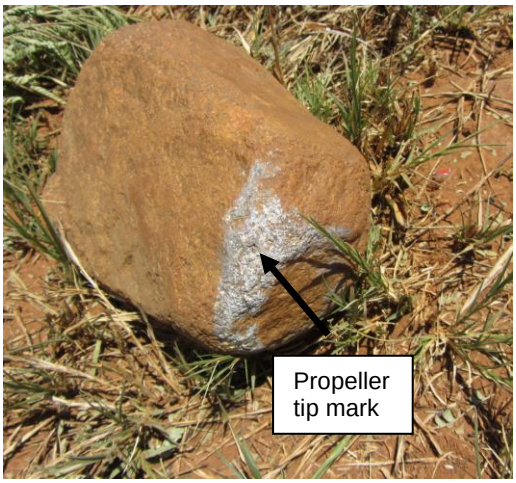


Figure 6 & 7: A small tree trunk severed by the left-hand propeller and a small rock with propeller tip marks.

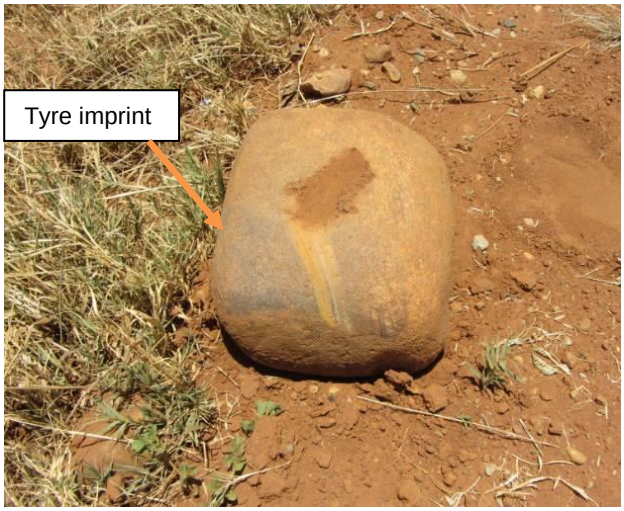


Figure 8: Tyre imprint on the rock surface.

1.12.2 The aircraft left a trail of skid marks on the left side of the road, indicating heavy braking covering 97.6m from the first point of touchdown. It was noted that rocks on the left edge of the road had tyre imprint marks as shown in Figure 8. At approximately 112m, from touchdown, the left landing gear strut assembly impacted an embankment and separated from the fuselage. It was noted that according to the ground marks, the aircraft veered to the left of the road after the left strut separated. The aircraft skidded on its belly and right wheel before the leading edge of the right wing impacted a tree. This caused the aircraft to ground loop to the right. The left-wing tip impacted the perimeter wall first before the leading edge collided with another tree, which stopped the ground loop. The aircraft came to rest facing north north-west. The distance from the first point of impact and where the aircraft came to rest was 280m.

Figure 9: Aircraft after it came to rest.

1.12.3 Investigation of the right-hand propeller revealed that the propeller was still intact, and the blades were at fine pitch. The right-hand engine was rotated, and it turned freely when the propeller was turned in the direction of rotation. The right-hand tank was drained from the purge valve and there was no fuel seeping out. The right-hand wing had substantial damage on the leading edge as well as at attachment point to the fuselage. The right-wing tip was also damaged during collision with the trees. The flaps were found selected in the up position and were still intact. Ailerons were checked for free movement by moving the yoke to the left and right, and the movement of the ailerons was found to be normal.

Figure 10: The right-hand propeller.

1.12.4 It was noted that the left-hand propeller had significant impact damage on both tips, which were bent backwards with the blades at fine pitch. The propeller blades had deep score marks across the face from the leading edge to the trailing ledge at a 45° angle. The propeller was turned by hand in the direction of rotation, and the engine was turning freely. The left wing had impact damage on the leading edge and the wing tip was substantially damaged. On-site inspection of the outside condition of both engines did not reveal any malfunctions.

Figure 11: The left-hand propeller.

1.12.5 The wing spar was cracked near the midsection during the impact sequence. The horizontal stabiliser was still intact although it had an impact mark on the left leading edge. The right-hand side wing filler cap was opened; a stem was inserted and came out dry. The left-hand side wing fuel cap was opened and there was ample fuel in the tank as shown in Figure 12 below. The vertical stabiliser was still intact and had no impact damages. The flaps were in the up position and were still intact. The right aileron was deflected upward and the left aileron down. The left aileron showed impact damage, but the right-hand aileron was still intact. The elevator was observed having a downward deflection and was still intact. The rudder was deflected to the right, which was consistent with the depressed right rudder pedal. A continuation check was conducted on the ailerons as the yoke was moved left to right inward and outward, which moved the ailerons and the elevator, respectively. The fuselage skin was cracked vertically on the right-hand side in the midsection.

The horizontal stabiliser was still intact, although it had impact marks on the left leading edge. The empennage was still intact. The seats were still attached to the rails. The seat belts were still intact and secured.

Figure 12: Fuel in the left tank.

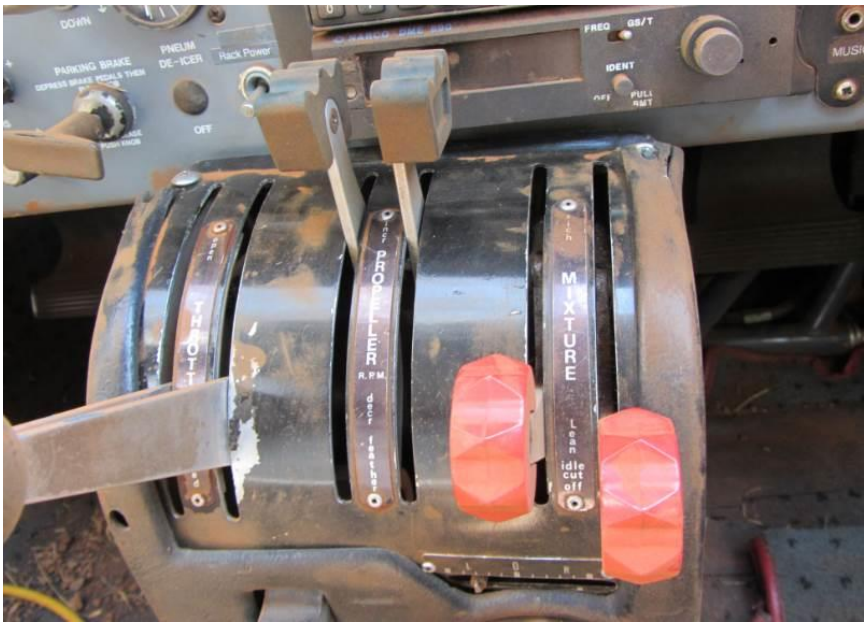


Figure 13: Engine and propeller controls (as found on the accident site).

1.12.6 The instrument panel inside the cockpit was still intact and all instruments were in their correct positions. The positions of the engine control levers as found on the scene of the accident were as follows: the mixture levers were in the idle cut-off position, the propeller pitch control levers were in the fine pitch position, and the throttle control levers were in the off position. The upper console was still intact. The

position of the engine fuel supply valve selectors as found on the scene were as follows: the left engine fuel selector control knob was pointing intermediate between the left- and the right-hand tank position; the right-hand engine fuel selector control knob was pointing to the shutdown position, the left-hand engine fuel selector control knob was stuck in the intermediate position between the left- and the right-hand tank position and could not be rotated, he right-hand engine fuel selector control knob was moving freely. All switches for the fuel pumps were in the off position. All circuit breakers were pushed in, except those that were intentionally pulled out and secured with cable ties.

1.13 Medical and Pathological Information

1.13.1 None

1.14 Fire

1.14.1 There was no evidence of pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was considered survivable as the cockpit structure was still intact and had no damage which would have inflicted injuries to the occupants. The pilot made use of the aircraft safety harness.

1.16 Tests and Research

1.16.1 Both the left- and the right-hand engine fuel selector valves were recovered and subjected to teardown examination at an approved AMO during the presence of the investigators. The right-hand fuel valve outside condition was not in a good condition as compared to the left-hand one as shown in Figure 14 and 15.

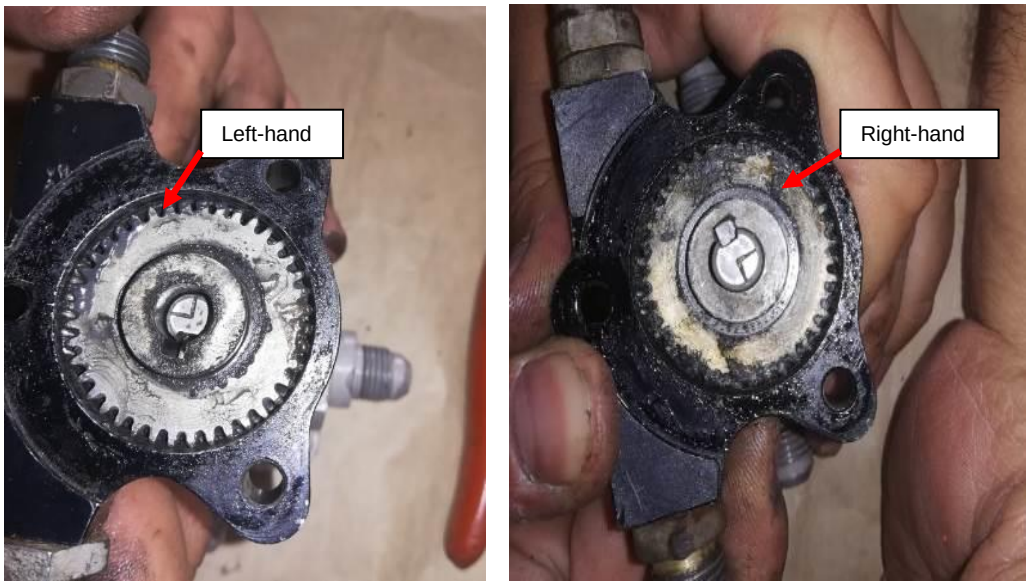
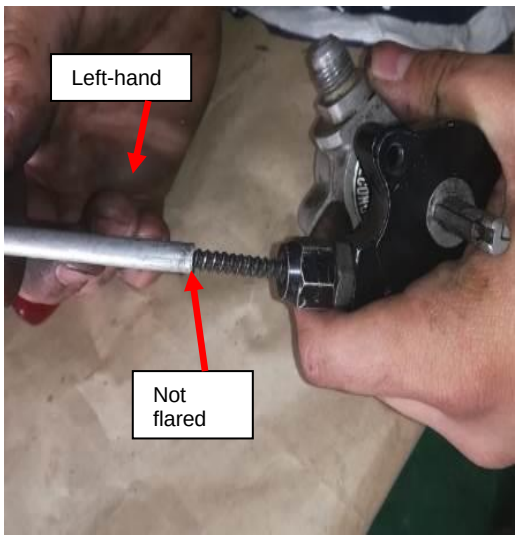


Figure 14 & 15: The worm wheel for left-hand and right-hand selector valve.

1.16.2 Figures 14 and 15 show the left- and right-hand selector valve worm wheel which was recovered and subjected to an inspection. The flex cable for the left-hand selector valve exhibited a kink 23mm from the beginning of the retainer nut for the conduit when the Teleflex cable was at minimum position stop. This kink was affecting freedom of movement of the Teleflex cable as it was binding inside the conduit and worm wheel casing during the selection, which was consistent with the selector valve in the cockpit. The selector valve was stuck in position to feed from the right-hand tank. During the teardown of the left-hand selector valve, it was noted that the conduit was out of its position and not retained by the nut. The conduit was not flared at the end as compared to the right-hand side one. During operation of the cable via the control knob, it was noted that the cable moved with the conduit during operation. During test, it was noted that the conduit was not flared as compared to the right-hand side as depicted in the Figures 16 and 17. Both valves exhibited good operation and inside conditions were good. The left-hand worm wheel revealed signs of insufficient lubrication whereas the right-hand worm wheel showed signs of enough lubrication inside it. The rest of the inspection report is appended in this report as Appendix A.



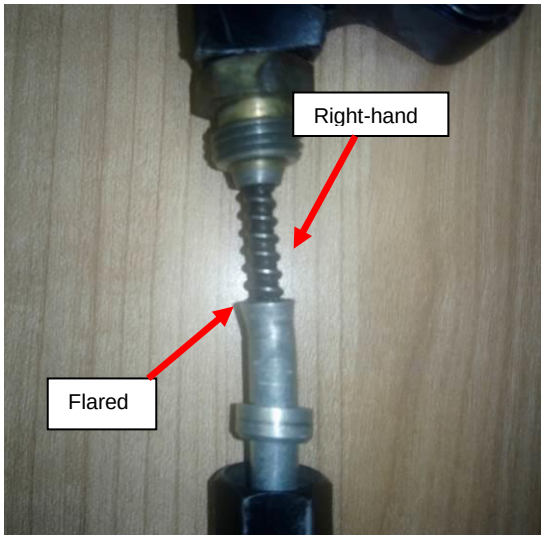


Figure 16 & 17: The left-hand and right-hand conduit.

1.16.3 Both fuel filters were recovered and subjected to teardown inspection by an approved AMO. Both filters were opened and checked. There were metal filings and sand as seen in the Figure 18 below. The creases of the micron filter had metal fillings and had sand stuck to it. The teardown inspection report is attached as Appendix A.

Figure 18: Debris and metal filings.

1.16.4 According to the technical report by the approved AMO who recovered the aircraft, ample fuel was drained from the left tank during the recovery of the aircraft. The right-hand tank was empty. The external conditions of the engines were inspected in accordance with maintenance manual and were found to be satisfactory according to the AMO. This was confirmed by the on-site investigation.

1.16.5 ***Procedure for best performance after engine failure during cruise flight (flight manual):***

1. Inoperative engine – SECURE (Refer to c-5 and c-9)
2. Operative Engine – Adjust as required
3. Trim tabs – Adjust
4. Fuel valves position
1 Inoperative Engine – ENG. SHUT-OFF
2 Operative Engine – On (also see Cross-feed Procedure)
5 Electrical Load – DECREASE to minimum required
6 As soon as practical – LAND

C-5 Inoperative engine:
1 Throttle – CLOSE
2 Propeller – FEATHER
3 Mixture – IDLE CUT-OFF

C-9 Inoperative engine – SECURE as follows:
1. Fuel selector – ENG. SHUT-OFF
2. Auxiliary Fuel Pump – OFF
3. Magneto Switches – OFF
4. Alternator – OFF

1.16.6 ***Section 3 (Flight Manual)***
Engine Inoperative landing
1 Operative engine
1) Fuel Selector – On
2) Mixture – Full Rich
3) Propeller – Forward
2 Flaps Selector – Extend 15°
*3 Approach Speed – 90 (*knots indicated air speed) *KIAS*
4 Flaps fully down only
5 Speed – Below 90 KIAS only when landing is assured

1.16.7 ***Fuel cross feed Procedure***

1. Right tank to left engine (Right Engine Shut-off):

(1) Left Auxiliary Fuel Pump – On
(2) Left fuel selector – RIGHT TANK
(3) Left Auxiliary Fuel pump – As Required

2. Left Tank to Right Engine (Left Engine shut-off):

(1) Right Auxiliary Fuel Pump – On
(2) Right fuel selector – LEFT TANK
(3) Right Auxiliary Fuel pump – As Required

3. Right Tank to Both Engines

(1) Left & Right Auxiliary Fuel Pump – On
(2) Left fuel selector – RIGHT TANK
(3) Left & Right Auxiliary Fuel pump – As Required

4. Left Tank to Both Engines

(1) Left & Right Auxiliary Fuel Pump – On
(2) Left fuel selector – LEFT TANK
(3) Left & Right Auxiliary Fuel pump – As Required

1.16.8 ***Fuel system independence (AFM)***

To render right side fuel system completely independent from left side fuel system, position each selector on to corresponding tank.

1.17 Organisational and Management Information

1.17.1 The AMO was in a possession of an approved AMO certificate issued on 19 December 2017, with an expiry date of 31 December 2018. The engineer who signed out the MPI in the logbook was equipped and authorised to release the aircraft.

1.17.2 The aircraft underwent a MPI from 8 October 2018 to 7 November 2018, however, a certificate of release to service (CRS) was not issued but the AMO allowed the pilot to operate the aircraft. CAR Part 43.04.2 requires the CRS to be issued after maintenance when the AMO is satisfied that the maintenance had been carried out.

1.17.3 The operator was in possession of a valid air operating certificate issued on 28 February 2017 by the Regulator, as well as an approved operation manual. According to the operator's part 135 operation manual (effective date 28 February 2017), section 7 paragraph 7.1.2.a.(iii) All pilots employed by the operator are required to have a minimum of a type rating with 50 hours on type.

1.18 Additional Information

1.18.1 The flight simulator Vulcanair and ZS-PBR fuel control selectors.

Figure 19: The flight simulator fuel control selectors.

Figure 20: Fuel control selectors for the aircraft (Vulcanair) used by the pilot during conversion.

Figure 21: Accident aircraft fuel control selectors.

1.18.2 Comparison between the accident aircraft and the aircraft and simulator that the pilot used for conversion did not reveal any discrepencies in the layout and position. The three fuel selector systems for both engines had a decal which had three positions: LH tank, RH tank and ENG shut-off for left-hand

side and RH tank, LH tank and ENG shut-off for the right-hand tank.

1.18.3 Propeller damage and revolutions per minute (RPM) (Source: Richard H Wood, aircraft accident investigation Chapter 11 subsection 3)

The prop blade is not straight, but is twisted forward at a blade pitch angle. If the RPM is high compared to the forward velocity, then the dominant force tending to bend the blade is the pitch blade angle and it tends to curl the end of the blade forward. On the other hand, if the RPM is low compared to the forward velocity, then the dominate force on the blade comes from the forward velocity. This, of course, tends to curl the end of the blade backward. Thus, this blade tip curling phenomena is really a function of the relationship between RPM and forward velocity. It is not a direct measure of RPM. The RPM may be high, but if forward velocity is also high, the blade tips are likely to curl backward. If the tips are curled forward, you can be sure that the prop RPM was not only high in relation to the forward velocity, but the propeller was being driven under positive power from the engine.

1.18.4 Spider track

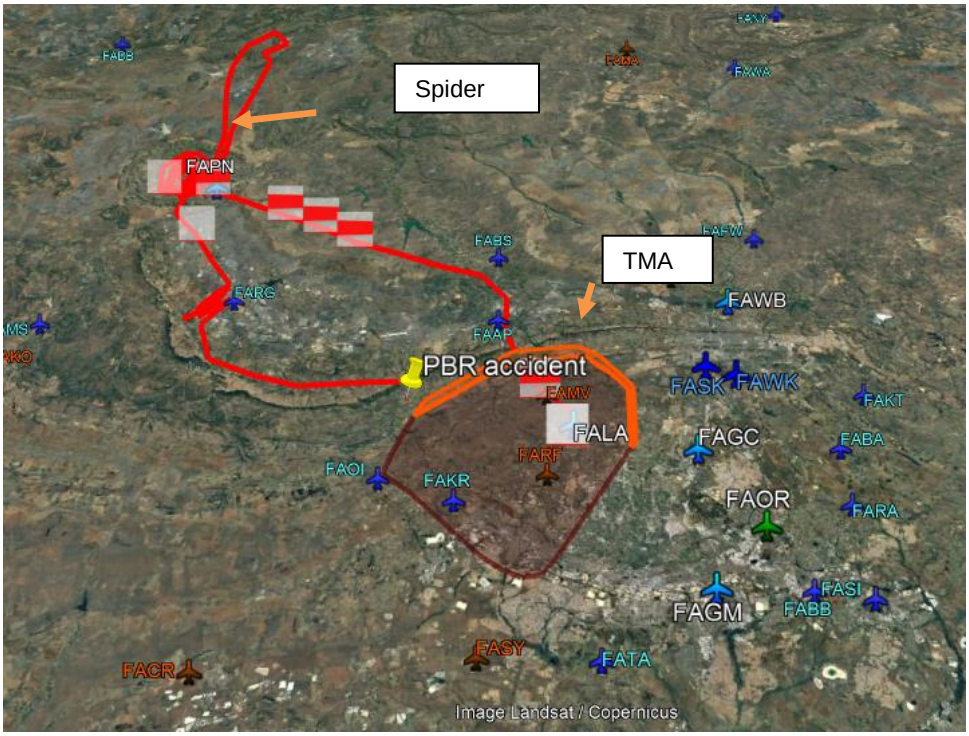


Figure 22: Spider track and TMA.

1.18.5 The Spider track (supplied by the operator) above represents the flight path of the aircraft. It was noted that the aircraft took off from FALA and routed to Pilanesberg airspace via Brits. The aircraft then went to Pilanesberg National Park and completed a race course pattern in that area. The aircraft was then noted flying towards Rustenburg area where it completed another race course pattern in the Tlhabane area before returning to FALA via the Magaliesberg mountain range ridge line. After crossing the ridge line at approximately 4nm, the track ended. It was noted that where the track ended the aircraft was still outside the terminal manoeuvring area (TMA), which is the controlled airspace for FALA. The area where the track ended was 17nm from FALA.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the evidence available, the following analysis was made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

2.2 Analysis

2.2.1 The pilot had a commercial pilot licence (CPL) issued on 13 January 2018 with an expiry date of 31 January 2019. The aircraft type was endorsed on his licence. The pilot was also issued with a valid medical certificate on 28 August 2018 with an expiry date of 31 August 2019 with no restrictions. The pilot completed a type conversion on 7 November 2018 where he did 1.0 hour actual flying and 1.0 hour simulator training. Since the conversion, the pilot only accrued 4.9 hours including the conversion.

2.2.2 The pilot was tasked to carry out a post MPI maintenance test flight. The pilot was not rated to carry out a post MPI maintenance test flight. SA-CAR Part 61.19.7 *requires the pilot to hold a maintenance test flight rating.* The pilot had not applied to nor received the maintenance rating from the regulator.

2.2.3 The right engine stopped operating due to fuel starvation as it was supplied from the right fuel tank which had been depleted.

2.2.4 When the right-hand engine started to surge and subsequently stopped, the pilot attempted to cross-feed by switching on the right-hand auxiliary fuel pump and turning the right-hand engine fuel selector control knob to supply fuel from the left-tank. In doing that, he omitted to switch on the left-hand auxiliary pump as required by the cross-feed procedure (both the left and right auxiliary pumps should be on during cross-feed). The omission to have the left auxiliary fuel pump on led to a partial fuel supply to the left engine as a result of the vacuum which had formed in the left engine fuel supply line where the right engine cross-feed line intersects with the left engine supply line, thus resulting in the left engine operating at partial power.

2.2.5 According to the AFM, the total fuel capacity of this aircraft is 538 litres, of which 520 litres is usable fuel and 18 litres is unusable. The fuel consumption for this aircraft is 91.2 litres per hour for both engines. The aircraft took off with both tanks filled to capacity and the aircraft was flown for 2.9 hours. The fuel used during the entire flight duration was 265 litres, which is just under the total capacity of the right fuel tank.

2.2.6 The left Teleflex cable conduit, which is a link between fuel selector in the cockpit and the fuel selector valve in the fuel system, had failed on its attachment bolt. This resulted in the cable which ran inside the conduit forming a kink and causing the left tank selector valve to have a partial movement when opened, closed or selected to cross-feed. The manufacturer issued a service bulletin (SB) 113 which mandated fuel selector control system detailed inspection at 100 hours intervals. Although the AMO indicated that they had incorporated SB 113 as part of the MPI, there was no evidence of the incorporation of SB 113, which could have prevented the failure of the Teleflex cable.

2.2.7 The aircraft underwent a MPI from 8 October 2018 to 7 November 2018, however, a certificate of release to service (CRS) was not issued but the AMO allowed the pilot to operate the aircraft. CAR Part 43.04.2 requires the CRS to be issued after maintenance when the AMO is satisfied that the maintenance had been carried out. The certificate of airworthiness lapsed on 17 June 2018 which required the AMO to apply for a special flight permit so that the maintenance acceptance flight can be carried out. The AMO contravene CAR 21.03.05 (see appendix C below). The AMO's application to SACAA for the C of A renewal was not completed due outstanding documents from the AMO.

2.2.8 The manufacturer issued a service bulletin 113 which is mandatory every 100hours. The purpose of the service bulletin was to supply more detailed instructions for the operational check of the fuel selector control system, scheduled for every 100 flight hours as per the ENAC approved current maintenance programme. The service bulletin was prepared to address specific reports of malfunction and improper fuel selector valve control system rigging and it has been issued to update maintenance procedures of fuel selectors and control system, to ensure its correct operations. Should this service bulletin been carried out the AMO would have recognised a latent defect and put defences and done necessary corrective action. There was no evidence found in the airframe logbook for compliance of mandatory service bulletin 113 during the last maintenance check.

2.2.9 The operator's part 135 operations manual (effective date 28 February 2017), section 7, sub-section 7.1.2(a)(iii) requires that, all pilots employed by the operator must have a minimum of 50 hours on type and (b) requires that, pilots should not be assigned as PIC after conversion to a new type of aircraft. The pilot had 4.9 hours on type of which 2 were accrued during conversion to the accident aircraft type.

2.2.9 The pilot stated that he realised that there was a fuel imbalance during the flight and he attempted to correct it but was unsuccessful. It is not clear why he did not return to base or divert to other aerodromes in the area.

2.2.10 The investigation revealed that the aircraft was flown with the cross-feed selected to supply fuel from the right tank for both engines. As a result, the fuel depleted, and the right engine stopped. When the right engine stopped, the pilot switched the fuel selectors to supply from the left tank and, in the process, omitted to switch on the left auxiliary fuel pump. As only the right fuel pump was switched on, a vacuum

formed in the left engine fuel supply line and that caused limited fuel supply to the engine which was configured to operate at cruise power. This resulted in the left engine losing power. With the left engine having lost power, sustaining a safe flight was impossible and the pilot elected to perform a forced landing.

3. CONCLUSION

3.1. General

From the evidence available, the following findings, causes and contributing factors were made with respect to this Accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this Investigation, the following sections are included in the conclusions heading:

- **Findings –** are statements of all significant conditions, events or circumstances in this Accident. The findings are significant steps in this Accident sequence but they are not always causal or indicate deficiencies.
- **Causes –** are actions, omissions, events, conditions, or a combination thereof, which led to this Accident.
- **Contributing factors –-** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident or incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2. Findings

3.2.1 The pilot was issued with a CPL on 13 January 2018 with an expiry date of 31 January 2019. The last competency check for commercial licence was done on 13 January 2018 with an expiry date of 31 January 2019. The conversion check was done on 7 November 2018, which consisted of 1.0 simulator hours and 1.0 actual flying hours. Since the conversion, the pilot only accrued 2.9 hours which added to a total of 4.9 hours. This flight happened two days after the pilot was signed off.

3.2.2 The pilot was in possession of a valid aviation medical certificate issued on 28 August 2018, with an expiry date of 31 August 2019 and no restrictions.

3.2.3 The pilot should not have operated as PIC on this aircraft as that is prohibited by the operator's part 135 operations manual.

3.2.4 The last annual inspection was carried out on 7 November 2018 at 4937.1 airframe hours. The aircraft only accrued 2.9 hours since its last maintenance.

3.2.5 The aircraft was issued with a certificate of airworthiness (C of A) on 18 June 2007, with an expiry date of 17 June 2018. The AMO's application to SACAA for the C of A renewal was not completed due outstanding documents from the AMO.

3.2.6 The aircraft was not issued with a certificate of release to service (CRS) following the MPI carried out from 8 October 2018 to 7 November 2018. The CRS that was found on-board the aircraft had lapsed on 9 September 2017 or at 4994.4 airframe hours whichever comes first. That contravened CAR 2011, Part 91.03.6.

3.2.7 The aircraft was issued with a certificate of registration (C of R) on 7 August 2008.

3.2.8 The aircraft was last flown on 17 March 2017 before the accident flight. The reason for the aircraft staying long on the ground was due to the left-hand engine removal for overhaul and the availability of spares for the engine.

3.2.9 The operator opted to task a pilot who recently completed a type rating and having accrued 2 hours to carry out a post maintenance acceptance flight. The operations manual requires a pilot-in-command (PIC) to have a minimum of 50 hours on type.

3.2.10 The Teleflex cable conduit had failed at the attachment bolt. The manufacturer issued a service bulletin (SB) 113, which was not incorporated during the last MPI. There were no records indicating that service bulletin 113 was complied with as mandated by the maintenance schedule.

3.2.11 The aircraft was flown using the right fuel tank for both engines for the duration of the flight and, hence, the fuel in the right fuel tank was depleted.

3.2.12 The right-hand engine stopped operating due to fuel starvation and the left-hand engine lost power due to partial fuel supply because of the omission to activate/switch on the left fuel pump.

3.2.13 The pilot, after realising that there was fuel imbalance, attempted to correct issue but was unsuccessful. It is not clear why he did not return to base or divert to an alternative aerodrome after realising that the fuel imbalance could not be rectified.

3.2.14 The AMO did not show compliance with proper maintenance of records as stipulated in Part 43-01-07. The airframe logbook service bulletin section was full and there was no new logbook opened for this aircraft.

3.2.15 The left fuel tank had fuel and the right fuel tank was empty at the time of the accident.

3.2.16 The investigation revealed that the aircraft was flown with the cross-feed selected to supply fuel from the right tank for both engines. As a result, the fuel depleted, and the right engine stopped. When the right engine stopped, the pilot switched the fuel selectors to supply from the left tank and, in the process, omitted to switch on the left auxiliary fuel pump. Because only the right fuel pump was switched on, a vacuum formed in the left engine fuel supply line and that caused limited fuel supply to the engine, which was configured to operate at cruise power. This resulted in the left engine losing power. With the left engine having lost power, sustaining a safe flight was impossible and the pilot elected to perform a forced landing.

3.3. Probable Cause/s

3.3.1 A combination of the right-hand engine fuel starvation and an omission to switch on the left auxiliary pump led to the right engine stopping and the left engine losing power. This resulted in the pilot conducting a forced landing.

3.4. Contributory Factors:

3.4.1 Flying using only the right-hand fuel tank for both engines for 2.9 hours.

3.4.2 Not returning to base or landing at an alternate aerodrome to investigate the cause of the fuel imbalance.

3.4.3 Not following the cross-feed procedure as stipulated in the AFM.

3.4.4 Lack of experience on the type of aircraft as the PIC had 2 hrs and this was in contravention of the operator's operations manual

3.4.5 The AMO not carrying out proper maintenance in that it did not notice the Teleflex cable conduit failure.

3.4.5 Failure to comply with service bulletin 113 which was issued by the manufacturer.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation, and are based on the conclusions listed in heading 3 of this Report; the AIID expects that all safety issues identified by the Investigation are addressed by the receiving States and organizations.

4.2. Safety Recommendation/s

4.1 It is recommended in the interest of safety to the Director of Civil Aviation to review the maintenance activities conducted by the AMO.

5. APPENDICES

5.1 Appendix A – Fuel selector examination report (Valve assemblies and gasculator)
5.2 Appendix B – Weight and balance graph
5.3 Appendix C – Extracts of CAR 2011
5.4 Appendix D – Special Flight permit form
5.5 Appendix E – Extract of SB 113

Appendix A: Fuel selectors examination

RE: ZS-PBR FUEL SELECTORS

Dear Sir

The following report was requested by you as to what was found when the strip down of the Fuel Selectors and fuel gascolators, of the above aircraft. Please note this is our opinion based on the facts of the inspection

The selectors of the above aircraft were brought to us to inspect and give a synopsis of the cause of the L/H valve that was stuck in a position.

The R/H valve, we were able to move the fuel selector flexible cable by pulling the flexible cable in and out of its guide tube easily.
The L/H flexible cable was stuck, and no amount of pressure could move the cable. When we removed the selector off the mount assembly, we found that the cable guide tube was able to pull out of the lock nut attaching the cable guide tube to the fuel control receiver. The fuel control cable was kinked inside the guide tube, thus binding the cable to the guide tube. We also found that there was no lubrication visible on the cable and the gear mechanism inside the fuel control receiver. Once we had straightened the cable the movement was easy and could be pushed in by hand.

The lack of lubrication and the kinked cable was the cause of the non-movement. The kinked cable was caused by the Cable Guide Tube not having the end flared to stop the guide from pulling out of the attachment nut. The mechanism inside the selector mechanism was stuck in a partial opening for cross feed operation but restricted due to the valve not moving all the way to the open the valve to have complete flow. The valve was stuck in a partial fuel shut off position thus restricting the flow to the L/H engine.

When disassembling the Gascolators, we found it very difficult to unscrew, loosen, the bowl from the head. Once the assembly was apart, we found the bowls to have debris in them. The debris consisted mostly of metal filings and sand, silica. The creases of the micron filter had debris stuck in the folds. It is in our opinion that the filter had not been cleaned in a while or that the aircraft was refueled by means of Jerry cans or drums.

Appendix B: Weight and balance graph

STANDARD CONFIGURATION

ITEM	WEIGHT (LBS)	ARM (Inches)	MOMENT (Inch. Pounds)
Basic Airplane	3344.412	14.08	47098.28
Revised Airplane	—	—	—
Pilot's Seat	198	37.40	7405.2
Copilot's Seat	—	17.40	—
Seat No. 3	—	5.75	—
Seat No. 4	—	5.75	—
Seat No. 5	—	34.13	—
Seat No. 6	—	34.13	—
Seat No. 7	—	34.13	—
Baggage (Max 400 lbs)	—	60.70	—
Fuel	821.6	30.30	24894.48
TOTAL WT.	4364.012	TOTAL MOMENT	64582.56

Figure 6-6
Sheet 1 of 2
WORK SHEET

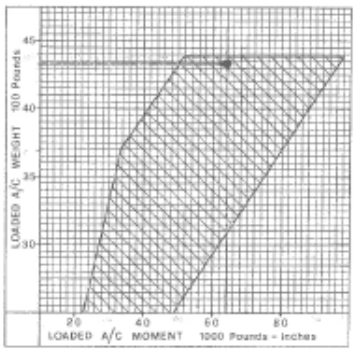


Figure 6-5
CENTER OF GRAVITY MOMENT ENVELOPE

Appendix C-Extract of CAR 2011

Part 21 Renewal of certificate of airworthiness

R*ENEWAL OF CERTIFICATE OF AIRWORTHINESS*

(1) Applicant for the renewal of a certificate of airworthiness shall demonstrate to the Director that:

(a) the aircraft conforms to an appropriate type acceptance or type certificate; and

(b) the aircraft is serviceable and in safe condition for flight at the time an application was submitted to the Director.

(2) In order to demonstrate the above, the information is submitted by completing the appropriate form (Annual Maintenance Review report prescribed under Document SA·CATS 43) which must be submitted with the prescribed application form:

(a) that the aircraft is serviceable and in safe condition for flight at the time the application was submitted to the Director;

(b) copy of the latest maintenance release certificate as prescribe in Document SA·CATS 43;

(c) record of the work accomplished since the last renewal of the certificate of Airworthiness:

(i) List of scheduled maintenance checks performed;

(ii) List of serialised list of components replaced and/or fitted;

(iii) Date of last weighing;

(iv) List of Airworthiness Directives performed;

(v) List of Manufacturers' Mandatory instructions for Airworthiness performed;

(vi) List of Modifications embodied;

(vii) Most recent flight folio page;

(viii) List of major repairs and the approvals;

(ix) Radio station license.

(3) The record of work accomplished may be submitted by:

(a) recording relevant data on the applicable annual maintenance review report form; or

(b) attaching relevant data certified by the appropriately rated AMO, to the applicable annual maintenance review report form; or

(c) attaching copies of the appropriate logbook pages to the applicable annual maintenance review report form.

(4) If aircraft is unserviceable at the time of the application for the renewal of the Certificate of Airworthiness, the owner/operator may lodge an application for such renewal together with appropriate fee as prescribed by Part 187. Once the outstanding documentation has been submitted to the Director, within a period of 365 days since the expiry date of the Certificate of Airworthiness, the Certificate of Airworthiness shall be processed. Furthermore, if the information provided demonstrates that the aircraft is serviceable, the Director shall process the application for the renewal.

(5) The following information must be furnished for the purpose of completing the appropriate application form for the renewal of certificate of airworthiness:

(a) aircraft registration;

(b) contact details of the Aircraft Maintenance Organization;

(c) details of the aircraft owner;

(d) details of the aircraft operator;

(e) description of the aircraft;

(f) Supporting documents such as;

(i) proof of payment;

(ii) annual maintenance review report;

(g) airworthiness certificate category and operational part required;

(h) delivery address of certificate of airworthiness; and

(i) declaration.

Certificate of release to service

91.03.7 *(1) No owner or operator of an aircraft shall operate—*

(a) a South African registered aircraft without holding a valid certificate of release to service signed by the holder of an appropriately rated AME licence or AMO approval; or

(b) a foreign aircraft without holding a valid certificate, equivalent to the certificate referred to in paragraph (a), issued by an appropriate authority.

(2) The owner or operator shall—

(a) ensure that one copy of the certificate of release to service or equivalent certificate is carried on board the aircraft to which it relates and, in the case of a South African registered aircraft, a second copy shall be filed at the normal station of the aircraft; and

(b) retain the certificate of release to service for a period of 12 months calculated from the date of issue of such certificate of release to service.

General

91.09.1 *(1) No owner, operator or pilot of an aircraft shall operate the aircraft unless such aircraft is maintained and released to service in accordance with the provisions of Part 24 or Part 43, as applicable to the aircraft.*

(2) An owner or operator may assign the responsibility for the maintenance and release of his or her aircraft to an approved maintenance organisation by means of a written agreement.

Aeroplane maintenance programme

91.09.2 *Each owner or operator shall ensure that the aeroplane is maintained in accordance with an aeroplane maintenance programme as specified in Document SA-CATS 43 or Document SA-CATS 24, as applicable.*

Maintenance responsibilities

91.09.3 *(1) The owner or operator of an aircraft, or maintenance organisation so assigned in accordance with regulation 91.09.01 (2), shall ensure that, in accordance with procedures acceptable to the Director—*

(a) the aircraft is maintained in an airworthy condition;

(b) the operational and emergency equipment necessary for an intended flight is serviceable; and

(c) the certificate of airworthiness or authority to fly, as applicable, of the aircraft remains valid.

(2) The owner or operator shall not operate the aircraft unless it is maintained and released to service under a system acceptable to the Director.

(3) When the maintenance release is not issued by an approved maintenance organisation in accordance with the provisions of Part 145, the person signing the maintenance release shall be licensed in accordance with the provisions of Part 66.

(4) The owner or operator shall ensure that the maintenance of the aircraft is performed in accordance with a maintenance programme acceptable to the Director.

Aircraft withdrawn from service for storage

43.02.21 *Aircraft withdrawn from service for storage shall meet the preservation instructions of the aircraft's manufacturer as prescribed in the relevant maintenance manuals, service bulletins, service letters or service instructions for the inoperative period. Before such an aircraft is returned to service, any prescribed maintenance shall be carried out prior to release to service*

Maintaining of records and logbooks

43.01.7 *The logbooks referred to in regulation 43.01.3 (1) shall be kept up to date and maintained in a legible and permanent manner.*

43.02.16 TEST FLIGHTS

1. General

(1)

The flight testing prescribed by CAR 43.02.16 shall be carried out by the holder of the appropriate test pilot rating issued in terms of Part 61, provided that the Director may approve the carrying out of flight tests by a person whose experience is considered to be adequate for satisfactorily assessing the flight characteristics and performance of a particular aircraft.

(2)

An aircraft that has undergone a major structural repair or a modification that may substantially affect its flight characteristics shall be flight-tested before it is returned to service. The outcome of the flight test(s) shall be passed to the owner or operator.

(3)

For complex aircraft the manufacturer's test flight procedure(s) may be utilised.

2. Requirements

(1) Recording of flight test results

(a)

When an aircraft is flight-tested, the results are to be recorded on the following flight performance records –

Form CA 21.19 for single-engine fixed wing aircraft;

Form CA 21.18 for multiple-engine fixed wing aircraft; and

Form CA 21.34 for helicopters.

(Editorial Note: Numbering as per official Civil Aviation Technical Standards.)

(b)

The forms referred to in paragraph (a) shall be forwarded to the Director within 48 hours after the completion of the flight test.

Requirements for certifying release to service

43.04.2 *No person shall certify an aircraft or aircraft component for release to service after maintenance unless such maintenance has been carried out in accordance with the provisions of this Part and, in respect of such maintenance, the aircraft or aircraft component is fit for release to service.*

Circumstances requiring a test pilot rating

61.19.7 *The circumstances that would require the pilot to hold a test pilot rating for the PIC include a test flight, maintenance test flight, import test flight and an experimental or a prototype test flight.*

Appendix D: Special flight permit

SPECIAL FLIGHT PERMIT

1. **Permit number**
2. **Full name of holder**
3. **Physical address of holder:** **Postal address of holder:**

5. **Aircraft nationality and registration marks**
6. **Manufacturer and manufacturer's designation**
7. **Aircraft serial number**
8. This Permit is issued pursuant to the Civil Aviation Regulations 2011, as amended, in respect of the above-mentioned aircraft which is considered to be airworthy when maintained and operated in accordance with the said Regulations and the pertinent operating limitations, subject to the following conditions:
   (a) The aircraft may not be operated over any foreign country without special permission from the authority of that country.
   (b) This Permit is issued for a flight from: *(Place)* **to:** *(Place)*
   (c) Aircraft being certified safe for intended flight. Aircraft to be released by an appropriately rated AME / AMO.
   (d) This aircraft may not be flown without the Owners' written permission.
   (e) Essential flight crew only.

Except in accordance with the applicable Regulations and in accordance with the condition and limitations which are prescribed by the Director as part of this Certificate.

9. **Date of expiry:**

Yours faithfully

[SIGNATURE]

NAME IN BLOCK LETTERS

For: DIRECTOR OF CIVIL AVIATION

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Appendix E-Extract of SB 113: *Operational test of the fuel control system*

2. WORK PROCEDURE (cont.)

2.4 FUEL SYSTEM OPERATIONAL CHECK

2.4.1 Tow the aircraft to a suitable engine test area.

2.4.2 Ensure that the quantity of fuel in the tanks is enough to guarantee at least thirty minutes of continuous engine operation.

2.4.3 Position the aircraft upwind, and place chocks under the main landing gear wheels.

2.4.4 Start both engines according to the procedure in the relative Flight Manual.

2.4.5 Run both engines at 1,500 RPM.

2.4.6 Place the left engine fuel selector control knob in the ENG SHUT OFF position and verify that the LH engine shuts down. **If engine does not shut down, replace the fuel selector control valve.**

2.4.7 Place the left engine fuel selector control in the LH TANK position.

2.4.8 Restart the LH engine and run at 1,500 RPM.

2.4.9 **For Aircraft from Serial Number 123 onwards:** Place the left engine fuel selector control knob in the ENG SHUT OFF position, and when it begins to shut down, place the selector control knob in the RIGHT TANK position and verify that the engine runs normally. If necessary turn on the electrical FUEL PUMP relative to the tank in use. Allow engine to run in this regime for at least 2 minutes.

2.4.10 **For Aircraft up to Serial Number 122:** Place the left engine fuel selector control knob in the ENG SHUT OFF position and when it begins to shut down, place the left selector control knob in the TANK OFF position and the right selector control knob in the CROSS FEED position. Verify that the engine runs normally. If necessary turn on the electrical FUEL PUMP relative to the tank in use. Allow engine to run in this regime for at least 2 minutes.

2.4.11 Repeat the applicable procedure above for the RH engine, inverting the selections as required.

2.4.12 Insert this Service Bulletin in the applicable Section of the Maintenance Manual until a new revision is issued.

2.4.13 Record compliance with this Service Bulletin in the aircraft Log-Book.

2.4.14 To ensure crewmembers are aware of the contents of the present Bulletin, insert a copy of this Bulletin in the Aircraft Flight Manual applicable section.